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Department of Fish and Game

John R. Woodworth, Director

Annual Project Closing Report

A SUMMARY OF FISH TRAPPING AT THE BYPASS PIPES OF IRRIGATION SCREENS ON THE UPPER SALMON RIVER DRAINAGE IN 1960, 1961, AND 1962

Project No. 922.2A — Contract No. 14-17-001-280

Project No. 161.4-IDA — Contract No. 14-17-0001-515

Columbia River Fishery Development Program

January 21, 1962

Report of Progress

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF SKETCHES

OPERATIONAL STUDIES

Annual Project Closing Report

Agency: State of Idaho Department of Fish and Game

Project Title: A summary of fish trapping at the bypass pipes of irrigation screens on the upper Salmon River drainage in 1960, 1961, and 1962

Project No.: 922.2A Contract No.: 14-17-001-280

Period Covered: July 1, 1960, to June 30, 1961

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Abstract

The construction of screens in canals that divert water from the upper Salmon River drainage began in 1958 in an effort to sustain the runs of anadromous fish that are found in this region. By the close of year 1962, there had been 163 irrigation screens built in this area.

In 1960, 1961, and 1962, a fishery biologist was employed to specify and enumerate the fish saved by these irrigation screens. This was accomplished by trapping the bypass pipe of several screens during the irrigation season.

In 1960, a total of 892 chinook salmon fingerlings were trapped at the bypass pipes of 8 screens in 557 irrigation days. In 1961, a total of 27,283 chinook salmon fingerlings were trapped at the bypass pipes of 14 screens in 1,334 irrigation days, and in 1962 there were 15,267 salmon trapped at 17 screens in 1,760 irrigation days.

INTRODUCTION

Columbia River Fishery Development Program

For a number of years several factors have contributed to the decline in numbers of the salmon and steelhead populations within the Columbia River drainage.

In 1938 the United States Congress sanctioned a program that was designed to maintain, reestablish and increase, if possible, the runs of salmon and steelhead in this drainage. This program, when it was activated in 1948, was known as the Lower Columbia River Fishery Development Program. At this time it encompassed only that area of the Columbia River that flowed below McNary Dam. Washington and Oregon were the only participants until 1956 when the program was expanded to include Idaho and the upper reaches of the Columbia River drainage. The major objectives of this program were, and are, to improve spawning habitat, remove migration blocks, build fish hatcheries where needed, and screen irrigation diversions. This treatise is concerned with that part of the Columbia River Fishery Development Program that deals with the screening of irrigation diversions.

After ~~some quite exhaustive~~ studies to determine the feasibility of screening irrigation canals on the tributaries of the upper ~~Columbia~~ Salmon River, the construction of irrigation screens began in 1958. At the end of the 1962 construction year there were 163 screens in operation. Since the original plans call for the construction of about 250 screens, this screening program is approximately 2/3 completed.

The major objective of this work was to measure the number and species of fish which were ~~saved~~ diverted from the canals by screens in the irrigation diversions of streams in the upper Salmon River drainage. Some of the minor objectives were to collect information on migration patterns, size of migrating salmon smolts, and factors that influence fish movement.

Description of area

The Salmon River originates in Stanley Basin from a large number of creeks, springs, and reservoirs. This river is responsible for draining approximately 3,760 square miles of central and eastern Idaho before it passes the city of Salmon. At this point the mean flow of the river is 1,281 cfs. The volume increases proportionately as tributaries empty into the river, until at Whitebird, Idaho, the river drains approximately 13,500 square miles of land and has a mean annual flow of 10,710 cfs. (U. S. Geological Survey, 1955).

This study is concerned only with the Salmon River and some of its tributaries above Shoup, Idaho, since this is where the Columbia River screen construction program is located. The tributaries involved include the North Fork of the Salmon River, Carmen Creek, Hayden Creek, and the Lemhi River.

The North Fork of the Salmon River is located near the eastern border of the state, about 25 miles North of Salmon, Idaho. This river drains approximately 180 square miles of the Bitterroot Mountains and has a mean annual flow of approximately[1/] 125 cfs. It flows in a southerly direction dropping 3,500 feet from its headwaters for 19 miles before emptying into the Salmon River at North Fork, Idaho. The stream has a rather steep gradient since the headwaters are 3,500 feet above its confluence with the Salmon River. This fact coupled with the steep gradient, the overall high altitude, the cold water, and the lack of nutrients,

1/ The mean annual flow of this river is an estimation because we have no records of water flow. No flow records are available.

Can you do this? I don't think so

of the
make(s) the North Fork Salmon River a relatively infertile stream.

upstream from
Carmen Creek flows into the Salmon River about 13 miles above the
of the (about 12 miles long)
North Fork Salmon River. This creek flows in a westerly direction from the
Bitterroot Mountains for 12 miles before emptying into the main Salmon
(an area of) (which is)
River. It drains approximately 54 square miles physically
similar to that of the North Fork drainage. Mean annual flow of this stream
is approximately 2/ 45 c.f.s. I don't think this is a figure you can
estimate!

The Lemhi River originates near Leadore, Idaho, from springs and
surface runoff. It flows for 62 miles in a northerly direction to empty
downstream from
into the Salmon River just (below) Salmon, Idaho. The valley containing the
Lemhi River is bordered on the east by the Bitterroot and Beaverhead Mountains
one-half
Ranges and on the west by the Lemhi Range. It varies in width from ½ to
seven
7 miles.

Flow records have been kept for the Lemhi River since 1955 by the
at Lemhi River mile 23 between the mouth of
U.S. Geological Survey. The gauging station is located just below Hayden
Hayden Creek and the town of Tendoy.
Creek, above the small town of Tendoy, Idaho. The mean flow recorded by
the U.S.G.S. between May and September, 1955, was 224 c.f.s. This value
any meaning
will fluctuate ~~violently~~ according to the seasons. Maximum discharge recorded on 1040 c.f.s.
accurred in
record was experienced on June, 1956, when 1040 c.f.s. was recorded. Minimum
124 c.f.s. in August of
discharge occurred the same year, in August, when 124 cfs was recorded.

resulting from melting snow in the headwaters
High water and flooding conditions are usually experienced in June.
These conditions are the results of melting snow and ice in the higher
elevations. Hayden Creek, by its location and peculiar drainage basin, why peculiar
is a major contributor to lower river flooding.
swells far above its usual capacity during June and is found to be the
major contributor to the flooding conditions that occur in the lower part
of the river at this time.

2/ There are no water flow records available for this stream.

Low water in the Lemhi River occurs in August and September, because, at this time, the snow melt has decreased and the river is being tapped heavily for irrigation water by the local ranchers.

The Lemhi River drainage was the area of major activity in screen construction, screen trapping, and collection of information, and therefore will receive emphasis in this report. Other streams that were previously mentioned will be covered in this report, but to a much smaller degree.

General life history of salmon in the Lemhi River

The adult chinook salmon that spawn in the Lemhi River are believed to be spring run fish only. These fish enter the mouth of the Columbia River in March and April and reach the mouth of the Lemhi sometimes as early as May (Bjornn, 1960). They move up the river during the high water in June and July to seek out deep holes and quiet areas in the river where they lie until the spawning period.

Spawning begins in early August and reaches a peak during the first part of September. Over 80 percent of the spawning activity occurs between the small town of Lemhi and the origin of the river. This distance represents only about one third of the length of the Lemhi River.

The deposited eggs hatch out during the first part of December and the resultant fry emerge from the gravel in early February (Gebhards, 1959). After emergence, the fry seek out quiet pools and eddies in the river. Some downstream movement of fry is displayed but this is believed to be only a dispersal of the fry from the crowded conditions of the spawning area. Any downstream movement, either by young-of-the-year fish or yearlings, occurs predominantly after dark. Very few fish have been caught in traps that were operated during daylight hours.

The young fry grow rapidly during the summer months and migrate from the river in the fall of the year or the succeeding spring. All yearling salmon that remain in the river after June are found to be precociously

matured males. These young salmon can be observed the following August and September on the spawning grounds, attempting to fertilize the eggs of adult female salmon that are sometimes ~~as large as~~ six times their size. Whether they are successful in fertilizing any eggs or contributing significantly to the stability of the population can only be speculated.

14

15

IRRIGATION PRACTICES

The irrigation season extends from

The ranchers in this area start irrigating in April, May, or June, depending upon the dryness of the particular year. Generally speaking, most of the ranchers are taking water from the river regularly by the middle of May. They continue to irrigate until the latter part of September or early October, again depending upon the year and prevailing weather conditions.

The size of the irrigation canals in the Lemhi Valley vary from a maximum size of 85 cfs to a minimum size of 1.5 cfs. The average is 13.5 cfs. Those canals having extra large capacities are usually owned and operated by two or more ranchers. Since these larger canals are used by more than one ranch they seem to flow at, or near, their full capacity throughout the entire irrigation season. The smaller canals operate much more intermittently, as a rule.

A TYPICAL IRRIGATION SCREEN

Sketch 1 depicts a typical irrigation diversion with a screen installed in the canal and both types of fish traps installed on the bypass pipe. The wing dam across the river is used to divert the water from the river into the canal (Figure 18 and 19). Wing dams are not found on all diversions, especially during high water, but; as the river recedes in July, August, and September, more ranchers build wing dams across the river in an effort to divert more water into their ditches. During drouth years the ranchers on the lower end of the river cannot get enough water to irrigate their fields adequately unless the ranchers above them release some of the water past their wing dams. These wing dams also prevent the migration of some adult salmon to their spawning grounds during dry years as well as exposing these salmon to predation and illegal fishing practices while they are concentrated below a dam. During a year of near average precipitation the majority of the adult salmon will ascend to the upper reaches of the river before the wing dams become a major migration problem.

Once the water is diverted from the river by the wing dam it flows through the headgate, into the canal and through the trash rack. The headgate controls the volume of water entering the canal, while the trash rack catches larger floating objects before they reach the screen. The water then passes down the canal and through a perforated steel plate that is housed in a concrete wall. After the water is filtered by the perforated plate, the movement of water is utilized to turn a paddlewheel, which in turn, activates a chain and vertical blade arrangement

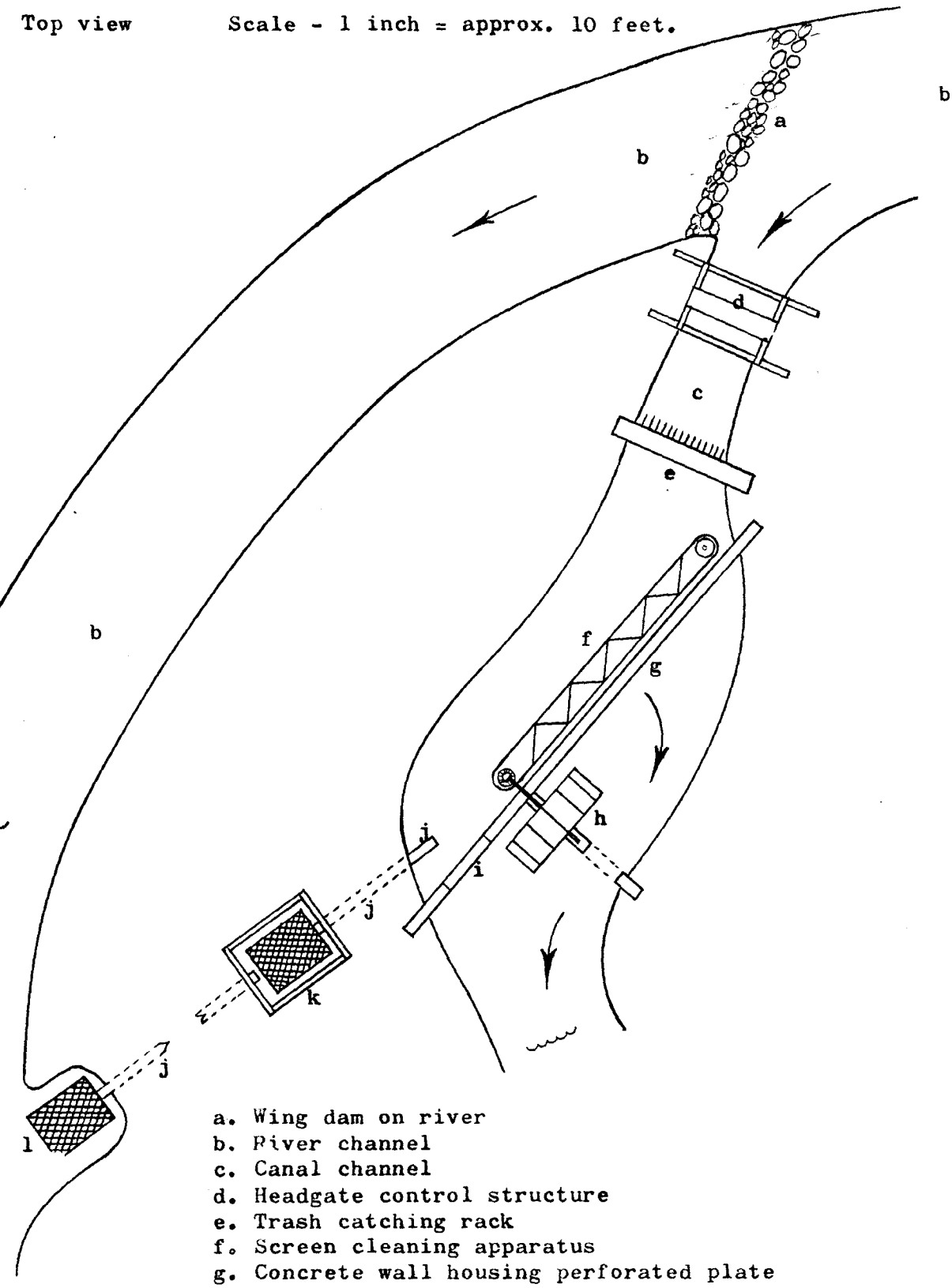
that wipes the trash and debris from the face of the perforated plate. Once the water has progressed beyond the paddlewheel it flows on down the canal to be flooded upon the fields by means of smaller headgates, canvas dams, sod dams, or other methods.

The electrical screens are operated in a similar fashion to that of the paddlewheel type except that the power to activate the vertical wiper blades is provided by an electrical motor, instead of a paddlewheel.

Migrating salmon smolts that are diverted into the canal can sense turbulence in the water behind them, or else, they actually come into physical contact with the screen and are deflected by it to the downstream end where the mouth of the bypass pipe is located. Here the smolts enter the bypass pipe and are shuttled back to the river channel.

Sketch 1. Diagram of typical* paddlewheel type irrigation screen

Top view Scale - 1 inch = approx. 10 feet.



a. Wing dam on river
b. River channel
c. Canal channel
d. Headgate control structure
e. Trash catching rack
f. Screen cleaning apparatus
g. Concrete wall housing perforated plate
h. Paddlewheel
i. Trip gate
j. Bypass pipe
k. Permanent type fish trap
l. Temporary type fish trap

* There are no screens with both types of fish traps.

TRAPPING SALMON FROM BYPASS PIPES

Some of the screens have a trap installed on the bypass pipe, as is shown in Figure 1. Any screen having a trap has only one type of trap, not both. Figure 1 has both a temporary trap and a permanent trap on the bypass pipe strictly for illustrative purposes.

Some of the traps used in 1960 and 1961 were built with a wooden frame that was covered with 1/4 or 1/6 inch mesh hardware cloth. These were temporary type traps that were 2 feet long by 2 feet wide and 2 feet deep. The permanent type traps were the same as those used in 1962 and are described in the following text.(Figure 21).

The temporary and permanent type fish traps that were used in 1962 are both 2 1/2 feet wide, 4 feet long, and 1 foot deep. They have frames constructed of 3/4 inch angle iron that is covered with aluminum plate perforated with 5/32 inch holes. All traps have full size detachable lids to remove the fish and debris from the trap. The traps are attached to the bypass pipes by way of a 6 7/8 inch sheet metal pipe that has one end welded to the metal trap and the other end fitted snugly around the bypass pipe.

The permanent type trap is located between the upper and lower end of the bypass pipe. It is protected by a wooden box that has been located below the surface of the ground in such a way that the metal fish trap can be lowered into the box and attached to the end of the pipe.

The temporary type trap is called " temporary ", because, it can be moved from one screen to another with very little effort. This type of

trap can be installed on the downstream end of the bypass pipe just by excavating a small area in the river bank to accommodate the trap and then attaching the trap to the pipe.

Once a trap had been installed on the bypass pipe of an irrigation screen, it was checked at regular intervals which varied from one to three days, depending upon the numbers of fish and the amount of debris being caught in the trap each day. The spring and fall of the year were the periods that required daily checks of the screen traps. During the spring larger numbers of young salmon were migrating downstream and high water conditions in May and June increased the load of trash and debris carried by the streams. In autumn the young salmon were again moving downstream and the floating leaves and algae helped to aggravate the maintenance problem. Fish movement and floating debris were quite negligible during the summer months so that servicing of the traps was only necessary every two or three days.

Each time these traps were checked a special form was used to record several types of information. The extent to which these forms were filled in varied in each case with the person who checked the trap, but there were parts of the form that were filled in consistently. The screen number, date, and the species and number of fish caught were always recorded on each occasion. A percentage of the game fish and salmon were measured each week and this information was also included on these forms.

TRAPPING OF IRRIGATION SCREEN BYPASS PIPES IN 1960

~~This was the first year to trap the bypass pipes of any screens or to attempt to evaluate the screening program in any way.~~ A measure of the number of fish being diverted by the screens was first attempted in 1960. Previous to this time there were not enough screens in operation to begin any type of reliable evaluation. By January of 1960, there were 60 screens in operation in the Salmon River drainage; 43 of these were located on the Lemhi River.

This was also the third year of screen construction and proved to be a year of experimentation and refinements with the mechanics of the screen as well as the trapping of salmon fingerlings.

pertinent to report

Personnel involved

The plan for the trapping of irrigation screen bypass pipes in 1960 was formulated by Ray Corning. Tom Welsh and Bill Davidson are responsible for the resulting field work and collection of information.

Collection of information

The methods used to collect the desired information were to trap the fish from the bypass pipes, separate these fish by species and count them, and then measure the length of all game fish. The tattooing of fish with different colors of water soluble dye was attempted in order to acquire information on speed of migration and also the approximate number of times a salmon smolt was diverted into an irrigation canal.

Fish movement

The trapping of bypass pipes began in May and continued into October (Figure 1). The number of traps in operation varied from one trap in May to eight traps in July and August. Figure 1 illustrates clearly that a

downstream movement of fish occured during the first part of the irrigation season and was detected even though only a few traps were in operation. This movement of salmon tapered off sharply in July and gradually decreased until October when the last screen with a trap on the bypass was shut off.

The monthly fish catch by species is graphically illustrated in Figure 2. Trash fish[1] comprised ~~the biggest part~~ most of the catch throughout the entire season with a total of 8,296 fish. A total of 892 salmon, 147 trout[2], and 190 whitefish were also trapped.

Species composition of the fish catch for each screen is depicted in Table 2. The screen numbered L-50[3] caught more salmon than the other screens that were trapped while L-7 caught many more trash fish than any other screen.

The lower section of the Lemhi River is much more heavily populated with trash fish than the upper parts of the river so it is to be expected that more trash fish would be caught in the traps located near the lower part of the river. Even though the largest catch of salmon was made in June, the largest number of trash fish was caught during August. These trash fish apparently did exhibit some downstream movement during the summer months but this movement would have also been exaggerated by having more traps in operation during this time of the year than during the first and last parts of the irrigation season.

1/ The term "trash fish", as used in this report, includes suckers, dace, sculpins, chubs, shiners, and lampreys.
2/ "Trout", as used in the 1960 records, includes rainbow, eastern brook, and dolly varden.
3/ Screens on all streams are numbered beginning with the number 1 at the mouth and counting progressively higher with each screen that is built farther upstream. The first letter in the name of the stream precedes the number. Example: The screen located nearest the mouth of the Lemhi River is L-1; the screen located nearest the origin of the river is L-63.

The number of trout and whitefish caught in the screen traps was fairly insignificant and would lead one to believe that their presence in the river is also insignificant. This is not true, however, since a good sized population of trout and whitefish is found in the Lemhi River. They evidently do not enter the diversions as readily as ~~avoid the screen traps by moving about more cautiously than the~~ downstream migrant salmon.

~~Irrigation pressure~~ Amount of water diversion

Table 1 shows the monthly fish catch in the screen traps and also the total number of days the traps operated each month. The number of days in operation per month can be used as an indicator of the relative irrigation activity throughout the 1960 irrigation season. The lack of irrigation activity in May is somewhat irregular and does suggest that there was more than the normal precipitation during the spring of this particular year.

The screen operating the longest was L-7 which was in operation for 113.3 days of the irrigation season (Table 3). The canal in which this screen is located is owned by a number of ranchers and therefore must have a relatively uniform flow. ~~required to operate quite steadily in order to irrigate their ranches sufficiently during the dry season~~. This canal has a capacity of 50 cfs and is one of the larger diversions on the river. The screen operating the least was L-51. This is a small canal, having a capacity of approximately 7cfs.

Growth of salmon

The curve in Figure 3 illustrates the rate of gr th of the young salmon during the trapping period. Rapid growth was experienced between May and July, but the rate of growth decreased between July and August and then again between September and October.

The water is warmest in August and apparently was warm enough to inhibit the growth of the young salmon during this time of the year.

The "growth slump" in October can be blamed, I think, upon sampling error. In September only 11 fish were measured and then only 12 fish were measured in October. More reliability could be placed upon this curve if larger samples of fish had been measured in September and October.

There was no clear line of distinction between age class 0 and age class 1 for salmon measured in May (Table 4). Not enough of the larger fish, which could have been age class 1, were measured to illustrate definite groupings and since no scales were taken, all of these fish were included in Figure 3 as age class 0 salmon.

The four largest fish that were measured in August were, by their extra large size, almost definitely precociously matured yearlings (Table 4). I have to say "almost definitely" because no scales were taken during this year to prove this statement.

Miscellaneous

A total of 568 salmon fingerlings and 70 young rainbow trout were tattooed with various colors of a water soluble dye on either the right or left side of the body and then released back into the Lemhi River. As stated previously, the purpose of this work was to acquire information on speed of migration and also the approximate number of times a salmon smolt was diverted into an irrigation canal. Only two marked fish were recaptured and both of these were recovered at the same site where they had been marked and released.

One reason for not obtaining any more recoveries was that many of the diversions below the release site were not screened and marked fish were lost in these open canals below the release site. Due to the large number of open diversions and the small number of marked fish recovered, this tattooing program was terminated in early July.

TABLE 1. MONTHLY FISH CATCH IN SCREEN TRAPS FOR THE 1960 IRRIGATION SEASON

LEMHI RIVER AND HAYDEN CREEK DRAINAGES

	May	June	July	August	Sept.	Oct.	Total
Chinook salmon (young of year and yearlings)	0	660	113	103	14	2	892
Trout 1/ (all sizes)	0	90	20	33	3	1	147
Whitefish (all sizes)	0	62	105	22	1	0	190
Trash fish 2/ (all species)	0	1,011	1,416	3,794	2,004	71	8,296
Total number of fish	0	1,823	1,654	3,952	2,022	74	9,525
Days traps were in operation	5.3	109.6	167.2	215.1	46.0	13.6	556.8

1/ Trout includes: rainbow, eastern brook, and dolly varden trout.

2/ Trash fish includes: suckers, dace sculpins, chubs, shiners, and lampreys.

TABLE 3. CATCH OF CHINOOK SALMON IN SCREEN TRAPS FOR THE

TABLE 2. SPECIES COMPOSITION OF FISH CATCH IN SCREEN TRAPS FOR THE 1960 IRRIGATION SEASON

LEMHI RIVER AND HAYDEN CREEK DRAINAGES

	L-7	L-24	L-29	L-40	L-50	L-51	L-57	HC-1	Total
Chinook salmon (young of year and yearlings)	38	0	37	23	730	15	40	9	892
Trout 1/ (all sizes)	18	1	1	14	74	3	7	29	147
Whitefish (all sizes)	159	2	2	13	3	0	6	5	190
Trash fish 2/ (all species)	7,857	157	31	9	188	12	13	29	8,296
Total number of fish	8,072	160	71	59	995	30	66	72	9,525
Days traps were in operation	113.3	53.6	49.0	65.7	90.3	39.8	60.3	85.1	557.1

1/ Trout includes: rainbow, eastern brook, and dolly varden trout.

2/ Trash fish includes: suckers, dace, sculpins, chubs, shiners, and lampreys.

TABLE 3. CATCH OF CHINOOK SALMON IN SCREEN TRAPS FOR THE 1960 IRRIGATION SEASON

LEMHI RIVER AND HAYDEN CREEK DRAINAGES

	May 1/			June			July			August			Sept.			Oct.		
Screens	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C
L-7	*	*	*	9	22.5	.4	8	17.0	.5	6	30.0	.2	13	30.1	.4	2	13.6	.1
L-24	*	*	*	*	*	*	0	16.7	0	0	31.0	0	0	5.9	0	*	*	*
L-29	*	*	*	*	*	*	3	9.0	.3	33	31.0	1.1	1	9.0	.1	*	*	*
L-40	*	*	*	4	23.9	.2	4	22.7	.2	15	18.0	.8	0	1.0	0	*	*	*
L-50	0	5.3	0	630	29.8	21.1	72	30.6	2.4	28	24.5	1.1	*	*	*	*	*	*
L-51	*	*	*	*	*	*	2	10.0	.2	13	29.8	.4	*	*	*	*	*	*
L-57	*	*	*	9	8.2	1.1	24	31.0	.8	7	21.1	.3	*	*	*	*	*	*
HC-1	*	*	*	8	25.2	.3	0	30.2	0	1	29.7	.1	*	*	*	*	*	*
Totals for month	0	5.3		660	109.2		113	167.2		103	215.1		14	46.0		2	13.6	
Totals for season	0	5.3		660	114.9		773	282.1		876	497.2		890	543.2		892	556.8	
Mean catch per day for all screens			0			4.6			.7			.6			.2			.1

1/ S/C = salmon caught, D/F = days fished, M/C = mean catch per day.

* Denotes screen trap was not in operation.

TABLE 4. LENGTH FREQUENCIES OF CHINOOK SALMON SMOLTS TRAPPED FROM THE LEMHI RIVER DURING 1960

Fork length in mm.	May	June	July	August	September	October
30						
40	12	6	1	1		
50	20	66	9	1		
60	7	110	23			
70	0	52	42	12		
80	1	15	19	19	1	
90	3[a]	4	2	30	3	2
100	2	4	4	20	3	7
110	1		2	5	1	2
120			2	2	2	
130					1	1
140						
150				1[b]		
160				3		
$\bar{X}$ age class 0	55.6	73.8	86.4	88.2	102.7	102.5

a/ The figures below are included in " $\bar{X}$ age class 0 " for month of May.(see text)

b/ The figures below are considered to be age class I fish.

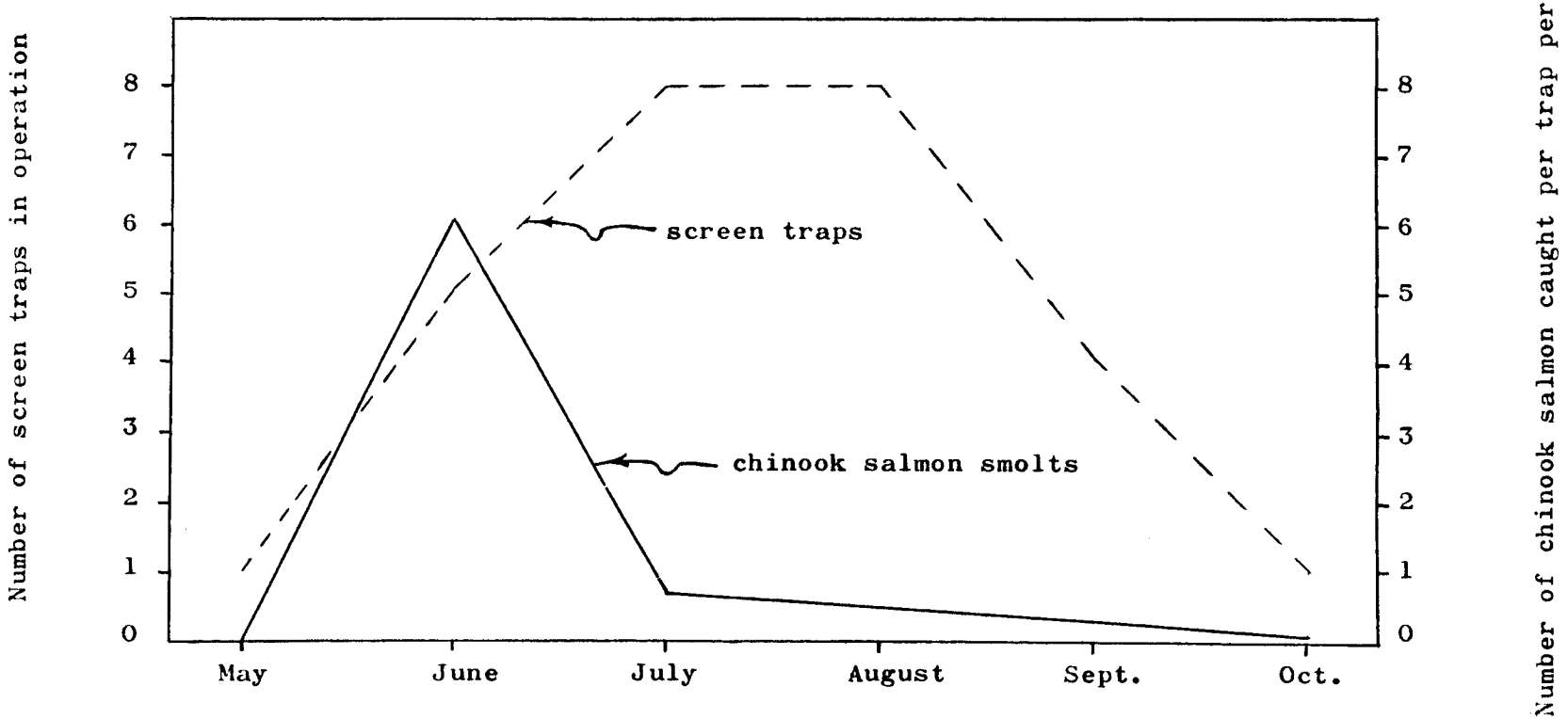


Figure 1. Rate salmon were caught and the number of screen traps in operation throughout the 1960 irrigation season.

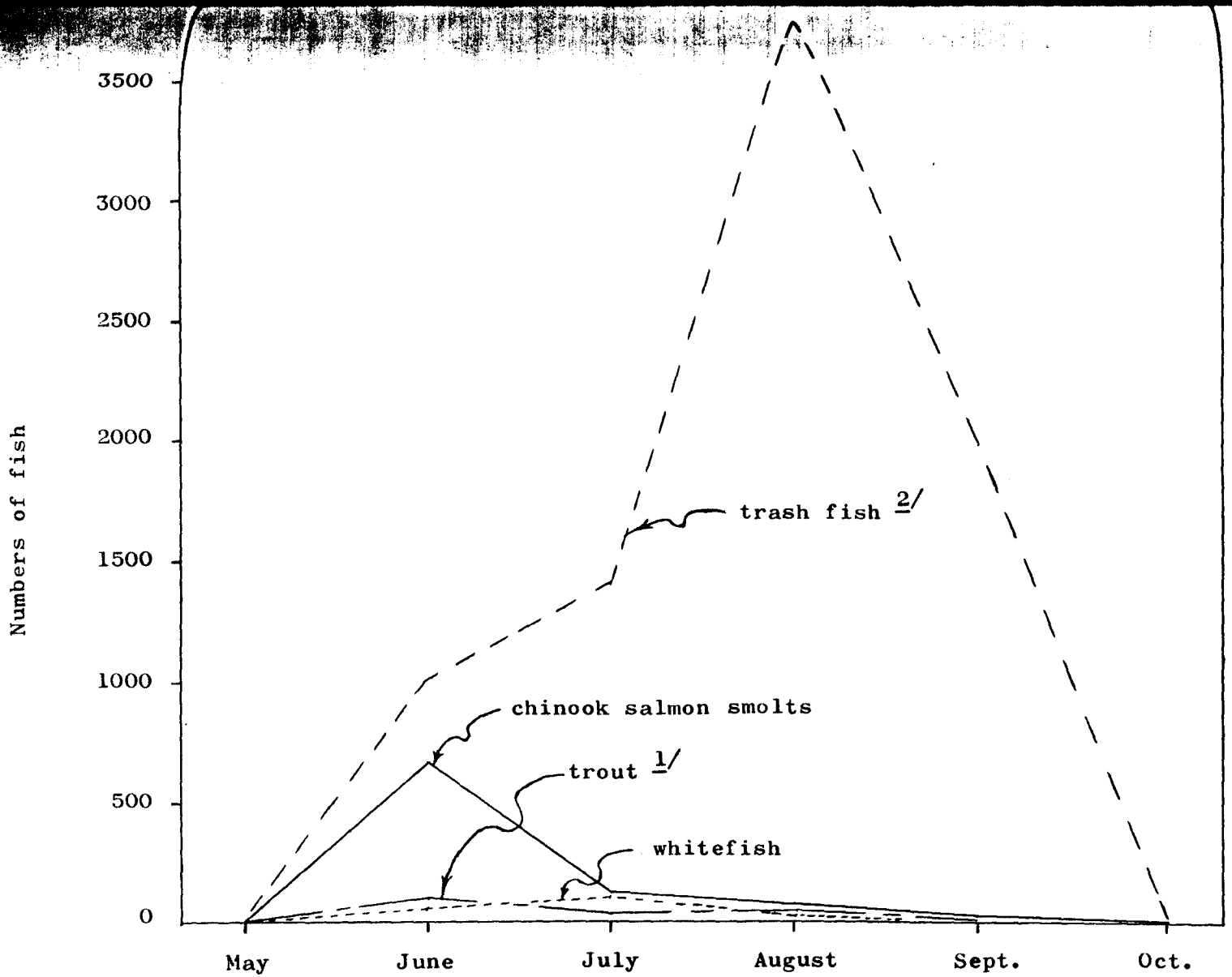


Figure 2. Monthly fish catch in screen traps for the 1960 irrigation season.

1/ Trout includes: rainbow, eastern brook, and dolly varden trout.
2/ Trash fish includes: suckers, dace, sculpins, chubs, shiners, and lampreys.

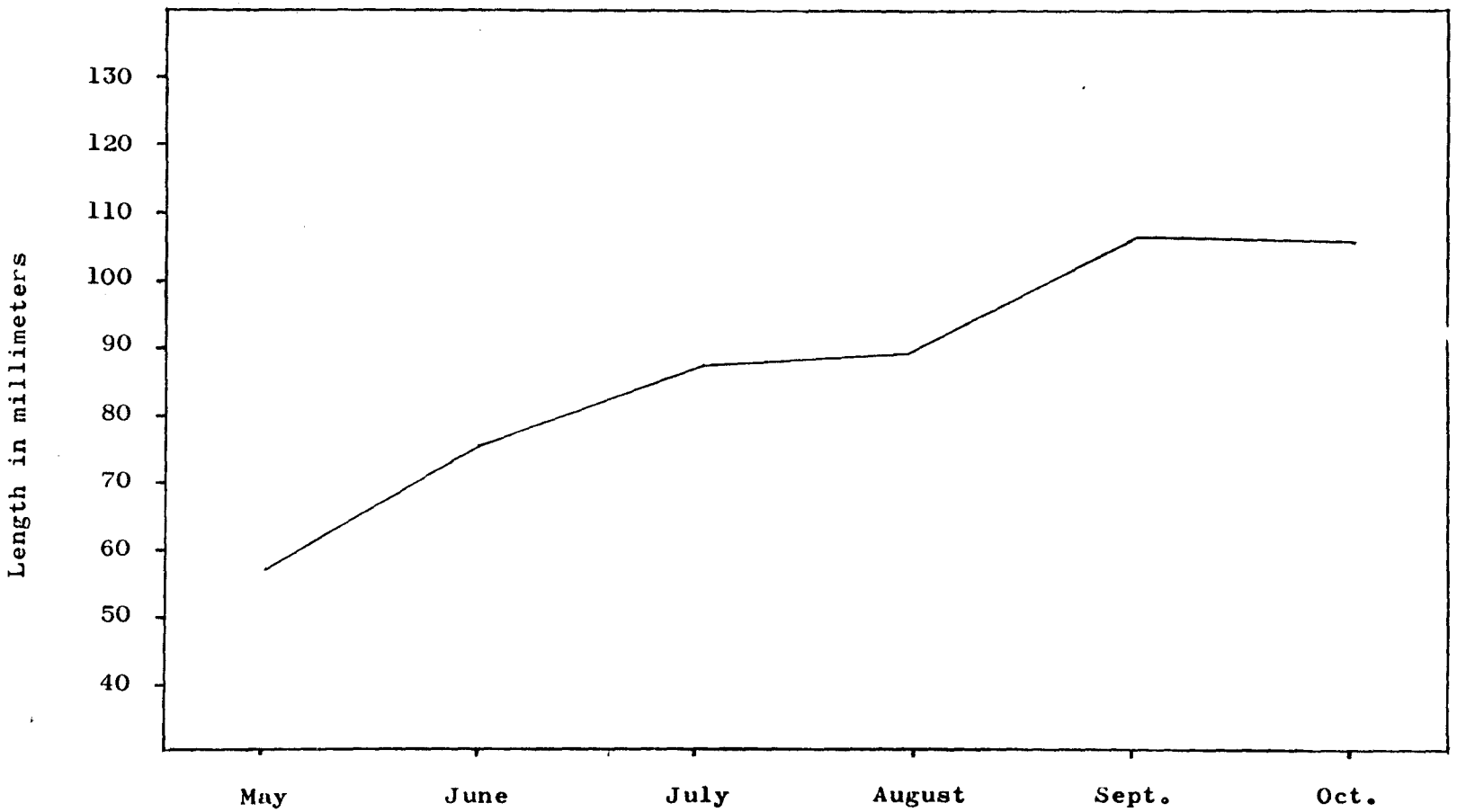


Figure 3. Average fork lengths of chinook salmon smolts trapped from the Lemhi River during 1960.

TRAPPING OF IRRIGATION SCREEN BYPASS PIPES IN 1961

The year of 1961 was the second year ~~to trap~~ the screen bypass pipes were trapped and the fourth year of screen construction. By January of 1961 there had been 82 screens constructed in the Salmon River drainage; 46 of these were located on the Lemhi River.

Personnel involved

Jerry Mallet was responsible for the screen trapping and the associated collection of information during this year. He was assisted by Bob Merrell in checking the traps for part of the irrigation season.

Collection of information

The methods used to collect information were to trap fish from the bypass pipes of various screens, separate the fish according to species, and count them, and then measure the length of the game fish[1]. Kray Meekin traps were also operated during the first part of the irrigation season to measure the amount of fish movement[2].

A Taylor Recording Thermometer was installed near the mouth of the Lemhi River on April 3, 1961. The record of this thermometer was changed each week by the person servicing the screen traps.

Fish movement

Screen trapping commenced in April and was terminated in September (Table 5). Total numbers of fish trapped for this year were: 12,395 yearling

[1] There were no growth curves drawn for the 1960 brood year because salmon fry were only measured during April and May in 1961.
[2] The data from these trappings is not included because of the limited use of the traps.

chinook salmon, 14,888 young of the year chinook salmon, 3 sockeye smolts, 899 rainbow trout, 72 eastern brook trout, 305 whitefish, and 7,877 trash fish. The largest catch of fish occurred in May when 16,619 fish were trapped (Figure 4). ~~In~~ June the catch had tapered off sharply and continued to decline until August when only 1,051 fish were caught in the traps (Table 5). In September the catch increased to a total of 3,097 fish for the month.

The curves in Figure 4 are misleading because it appears to the reader that the greatest amount of fish movement ~~transpired~~ occurred in May. There were more fish caught in May because more traps were in operation to catch fish. The curve representing the rate of salmon catch in Figure 5 depicts the magnitude of movement much more accurately than those of Figure 4 because here a rate of catch has been plotted instead of totals for the months. This rate of catch is very convenient to use since it is not biased by the number of traps used or the number of days these traps were operated.

Species composition of the fish catch for each screen trap is presented in Table 6. Screen numbered L-6 caught the largest number of yearling and young of the year salmon of any trap on the Lemhi River. This is to be expected since L-6 is the largest irrigation canal on the Lemhi River, and also, is located at the lower part of the river, so that virtually all salmon smolts that are produced in the Lemhi River must migrate down the river, past the intake of the large L-6 canal, or enter the mouth of the canal and be deflected by the screen into the bypass pipe, and then into the fish trap.

The total number of fish or total number of salmon caught by each trap, however, is not found to be directly proportional to the size of the canal. The size of the canal is probably the most important single factor that influences the number of fish that is diverted into the canal but other

factors that also influence the number of fish caught by a canal are the number of days it was operated during the month, the area where it is located upon the river, and the manner in which water is diverted ~~relative efficiency of the canal in diverting fish~~ from the river.

The maximum and minimum temperatures for the Lemhi River near its mouth were averaged separately for each week throughout the year and are presented as curves in Figure 6. The break in each curve between August 11 and September 17 is caused by the lack of records during this time.

Maximum water temperature was experienced on July 15 and 22 when 74° Fahrenheit was recorded between 3 p.m. and 4 p.m. on both days. On these days the water temperature was above 70° F. for approximately 6 hours. There were several days during July when the water temperature rose above 70° F. in the afternoon.

Minimum recorded water temperature was 32° F. and was experienced from December 6 until December 26. The thermometer was not operated after December 26, 1961.

The only correlation that seems to exist between smolt movement and water temperature is that water temperature was highest and fish movement was lowest during July. The greatest fish movement occurred in April when the average temperature fluctuated above 40° F. and below 50° F. This finding agrees with Gebhard's (1959) statement that, "Migration peaks generally occurred when the median daily water temperatures reached 40° Fahrenheit". The median daily water temperature reached 40° F. again in October, 1961, but since our salmon screen trapping terminated in September, we have no measure of fish movement at this time, and therefore, cannot compare one with the other.

Amount of water diversion
~~Irrigation pressure~~

The number of days that the traps were in operation indicates that May, June, and July were the months of highest demand for irrigation water (Table 5). Since April and September were the first and last months of the irrigation season, they are quite expectedly the months of the least demand for irrigation water.

The number of days that each screen trap was operated during each month is presented in Table 7. The irrigation period for some of the canals is depicted accurately in this table, but for other canals the figures are misleading. They mislead the reader because the columns labeled "D/F" are actually the number of days that each screen trap was in operation and not the number of days that the screen and canal were operated. The number of screen trapping days will vary from the number of irrigation days because of the difficulties involved in maintaining a screen trap. Some of these difficulties are: plugged bypass pipes, excessive amount of debris in the trap causing the lid to be forced off, destruction of traps by vandalism, and deterioration of traps from normal use.

TABLE 9. MONTHLY FISH CATCH IN SCREEN TRAPS FOR THE 1961 IRRIGATION SEASON

SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES

Species	April	May	June	July	August	Sept.	1961 total
Chinook salmon (yearlings)	1833	9788	336	64	221	153	12,395
Chinook salmon (young of year)	8154	3770	734	302	548	1,380	14,888
Chinook salmon (total)	9987	13,558	1,070	366	769	1,533	27,283
Sockeye salmon (smolts)	0	3	0	0	0	0	3
Rainbow trout (all sizes)	78	482	163	61	58	57	899
Brook trout (all sizes)	10	14	7	4	9	28	72
Whitefish (all sizes)	6	76	58	97	12	56	305
Trash fish 1/ (all species)	1,528	2,486	1,029	1,208	203	1,423	7,877
Total number of fish	11,609	16,619	2,327	1,736	1,051	3,097	36,439
Hours traps were in operation	3,551	5,850	6,096	5,880	5,328	5,280	31,985
Days traps were in operation	147.9	243.8	254.0	245.0	222.0	220.0	1,332.7
Number of screens trapped	10	14	12	10	9	12	

1/ Trash fish includes: Suckers, Dace, Sculpins, Chubs, Shiners, and Lampreys.

TABLE 6. SPECIES COMPOSITION OF FISH CATCH IN SCREEN TRAPS FOR THE 1961 IRRIGATION SEASON

Species	SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES																	1961 total
	L-6	L-7	L-24	L-29	L-40	L-47	L-50	L-58C	L-61	L-63	HC-1	S-5&6	S-7	S-10	NF-4&5	CC-1	CC-2	
Chinook salmon (yearlings)	5152	3430	2	118	1799	67	307	9	339	62	68	00	527	0	514	0	1	12,395
Chinook salmon (young of year)	2655	2191	2404	447	448	66	1187	84	637	182	794	0	20	23	3742	8	0	14,888
Chinook salmon (total)	7807	5621	2406	565	2247	133	1494	93	976	244	862	0	547	23	4256	8	1	27,283
Sockeye salmon (smolts)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Rainbow trout (all sizes)	35	31	2	55	70	7	46	13	274	89	70	0	13	1	164	28	1	899
Brook trout (all sizes)	0	0	0	0	0	0	0	0	0	72	0	0	0	0	0	0	0	72
Whitefish (all sizes)	26	41	1	74	1	4	5	1	81	61	2	0	1	0	0	7	0	305
Trash fish 1/ (all species)	1150	2594	115	1174	18	1	267	67	144	354	61	428	888	350	210	50	6	7877
Total number of fish	9018	8287	2524	1868	2336	145	1812	174	1475	820	995	428	1452	374	4630	93	8	36,439
Hours traps were in operation	1433	2848	427	3186	1256	696	2393	2230	2971	4054	2434	144	905	144	3694	2587	583	31,985
Days traps were in operation	59.7	118	18	132.7	52.3	29	99.8	92.9	124	169	101.4	6	37.7	6	153.9	108	24.3	1,332.7

1/ Trash fish includes: Suckers, Dace, Sculpins, Chubs, Shiners, and Lampreys.

TABLE 7. CATCH OF CHINOOK SALMON IN SCREEN TRAPS FOR THE 1961 IRRIGATION SEASON

SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES

Screen	April 1/			May			June			July			August			Sept.		
	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C	S/C	D/F	M/C
L-6	2664	21	126.8	5132	27.5	186.6	11	8	1.4	*	*	*	*	*	*	0	3	0
L-7	2607	23	113.3	2857	22	129.8	51	28	1.8	24	30	.8	0	4	0	82	12	6.8
L-24	2397	16	149.8	9	2	4.5	*	*	*	*	*	*	*	*	*	*	*	*
L-29	*	*	*	231	11	21.0	91	30	3.0	33	30	1.1	7	31	.2	203	31	6.5
L-40	1160	11.5	100.8	1080	27	40.0	7	14	.5	*	*	*	*	*	*	*	*	*
L-47	*	*	*	*	*	*	133	14	9.5	0	15	0	*	*	*	*	*	*
L-50	*	*	*	5	1	5.0	505	30	16.8	246	19	12.9	425	31	13.7	313	19	16.5
L-58C	3	4	.7	53	27	1.9	7	17	.4	0	23	0	0	10	0	30	12	2.5
L-61	*	*	*	74	14	5.3	148	30	4.9	47	30	1.6	284	31	9.2	423	19	22.2
L-63	0	17	0	7	31	.2	19	30	.6	9	30	.3	44	30	1.5	165	31	5.3
HC-1	544	11	49.4	291	25.5	11.4	20	11	1.8	0	8	0	7	27	.3	0	19	0
S-5&6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	6	0
S-7	161	15.5	10.4	386	22	17.5	*	*	*	*	*	*	*	*	*	*	*	*
S-10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	23	6	3.8

TABLE 7. continued

Screen	April S/C	April D/F	April M/C	May S/C	May D/F	May M/C	June S/C	June D/F	June M/C	July S/C	July D/F	July M/C	August S/C	August D/F	August M/C	Sept. S/C	Sept. D/F	Sept. M/C
NF-4&5	450	10	45.0	3433	29	14.9	77	27	2.8	0	30	0	2	27	.1	294	31	9.5
CC-1	*	*	*	0	1	0	1	15	.1	7	30	.2	0	31	0	0	31	0
CC-2	1	19	.1	0	5	0	*	*	*	*	*	*	*	*	*	*	*	*
Totals for month	9987	148		13558	245		1070	254		366	245		769	222		1533	220	
Totals for season	9,987	148		23,545	393		24,615	647		24,981	892		25,750	1,114		27,283	1,334 2/	
Mean catch per day for all screens			59.6			31.3			3.6			1.7			2.7			6.1

1/ S/C = salmon caught, D/F = days fished, M/C = mean catch per day.

2/ The total number of days fished does not agree with other tables because the monthly totals for each screen were rounded off to one decimal place.

* Denotes screen trap was not in operation.

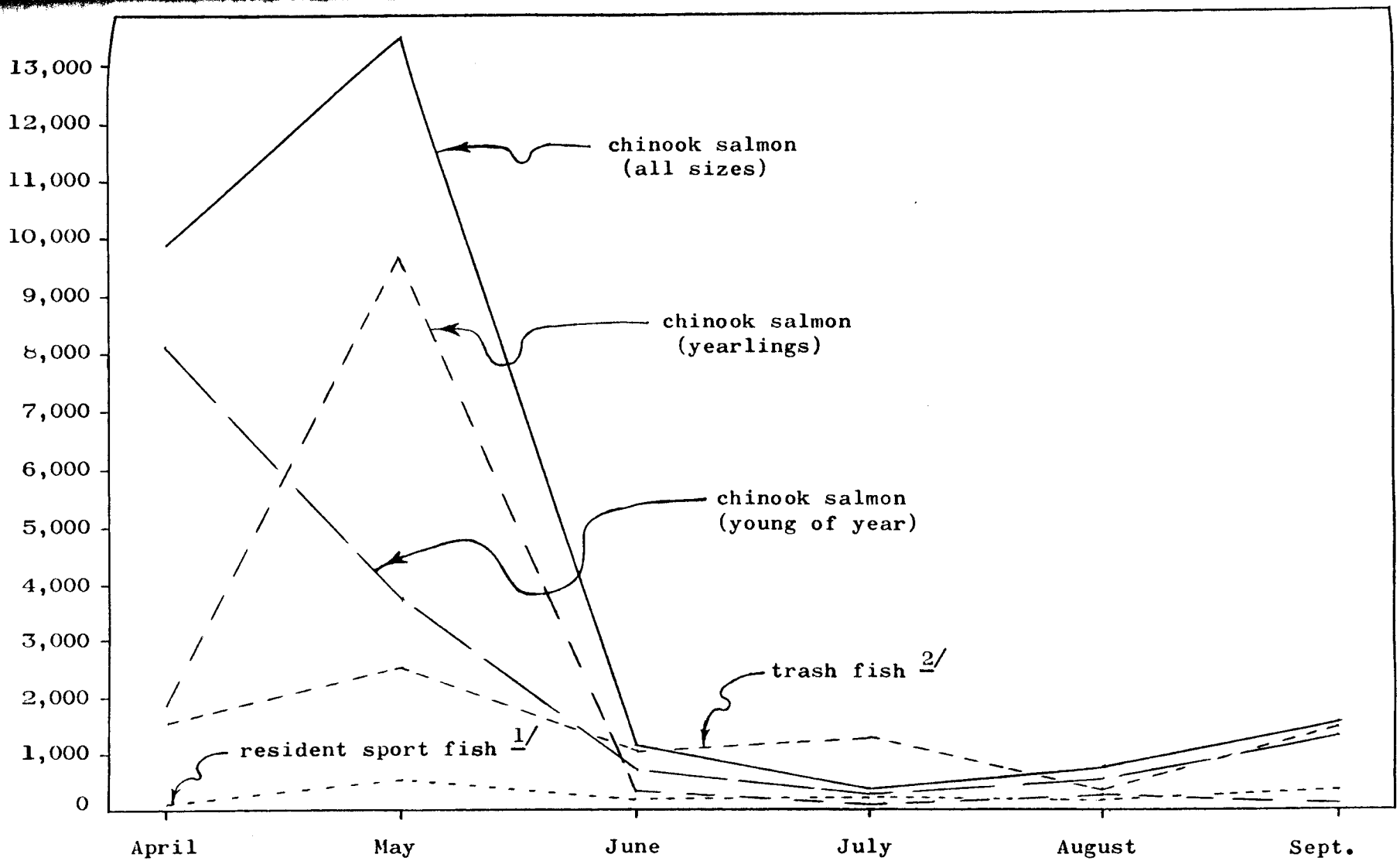


Figure 4. Numbers of fish caught in all screen traps throughout the 1961 season.

1/ resident sport fish includes: rainbow trout, brook trout, and whitefish.

2/ trash fish includes: suckers, dace, sculpins, chubs, shiners, and lampreys.

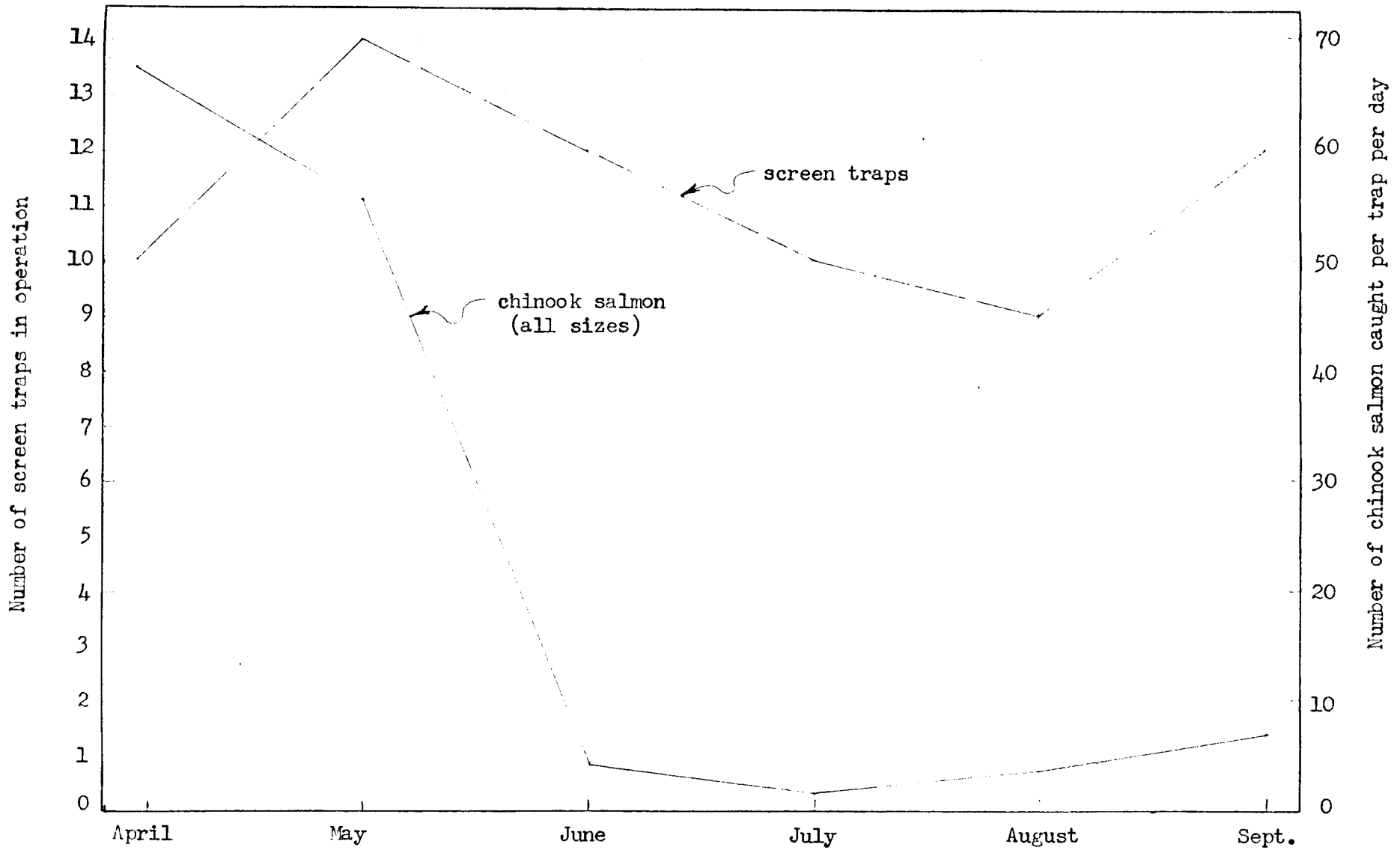


Figure 5. Rate salmon were caught and the number of screen traps in operation throughout the 1961 irrigation season.

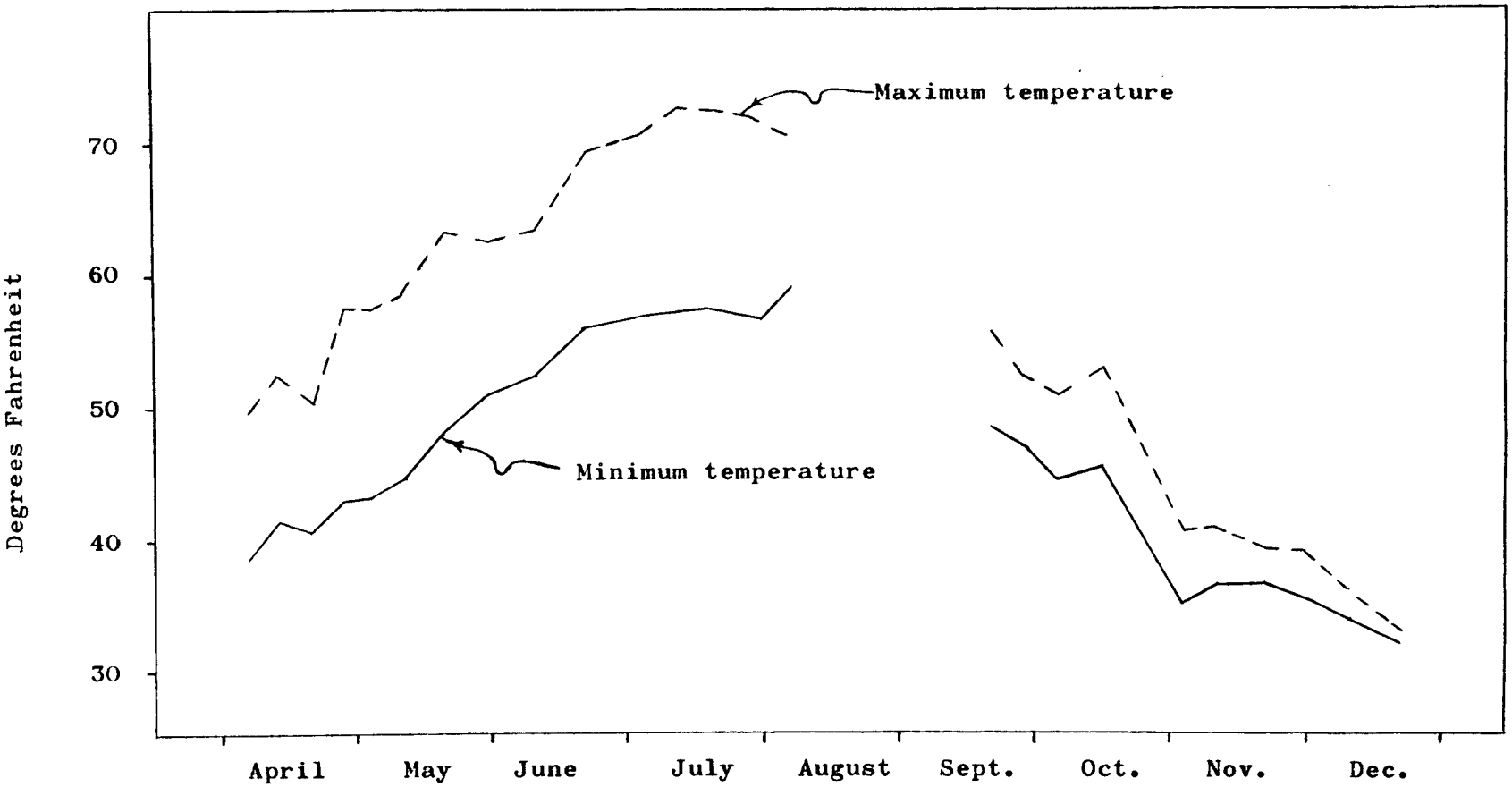


Figure 6. Weekly mean maximum and minimum temperature recordings for the Lemhi River during 1961.

TRAPPING OF IRRIGATION SCREEN BYPASS PIPES IN 1962

By January of 1962 there had been 131 irrigation screens completed in the Salmon River drainage. By June of this same year all open irrigation diversions of any consequence, on the Lemhi River, had been screened. The total number of screens on the Lemhi River is now 84 structures.

Personnel involved

The Area Biologist, Ted Bjornn, planned the screen trapping program for 1962. Don Corley was responsible for the field work, collection of information, and compilation of this data. Mike Warren and Weston Lowe assisted in the field work by checking the screen traps during a part of the irrigation season.

Collection of information

a. The methods used to collect the desired information during this year again consisted of trapping fish from the bypass pipes, separating them by species, counting them, and then measuring the length of a percentage of the salmon.

b. A Kray Meekin trap was operated at least once a week near the mouth of the Lemhi River to measure fish movement.

c. Continuous water temperature records were again kept for the Lemhi River.

Gauge boards were installed to measure the relative change in water volumes. One of these gauge boards was placed at the mouth of the Lemhi River and one near the middle of the river, just above Hayden Creek. Another gauge board was placed at the mouth of Hayden Creek.

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Fish movement

Screen trapping in 1962 commenced when L-7 screen was put into operation on April 18 and continued until October 31 when L-63 and L-7 were shut off. The total number of fish trapped for this year were: 2,940 yearling chinook salmon, 12,327 young of the year chinook salmon, 2 sockeye salmon smolts, 612 rainbow trout, 39 brook trout, 1,120 whitefish, and 26,160 trash fish (Table 8).

The largest catch of fish occurred in May when 10,979 fish were caught in 17 screen traps (Table 9). The majority of these fish were trash fish, however (Figure 7). In September a total of 4,418 salmon were caught in 15 screen traps, making this the month with the highest salmon catch for the season.

The large number of salmon caught in September is deceiving because it appears that salmon movement was greatest during this time. When the salmon catch is converted into a rate, the actual magnitude of fish movement can be depicted. Figure 8 shows that the rate of salmon migration was actually greater during October than any other month of the irrigation season.

When the rates of salmon movement are compared for 1960, 1961, and 1962, as is shown in Figure 9, it can be readily seen that the greatest downstream migration of salmon smolts occurs during the first and last part of the irrigation season. The 1961 season experienced a much higher rate of salmon migration in April and May than was seen in 1960 or 1962.

This large 1961 spring migration cannot be attributed, solely, to water temperature, as one can see, if the fish movement during April and May for 1961 and 1962 is compared with the water temperature records during these times (Figure 10). There is a very general correlation between fish movement and water temperature but nothing specific enough to set

a definite temperature range in which fish movement is greatest.

When one compares the Kray Meekin trapping rates with the mean weekly water temperature, it again can be seen that there is a very general correlation between water temperature and fish movement (Figure 12). There seems to be a closer relationship between water volume and fish movement than temperature and fish movement, but, it appears very logical and likely that both water volume and temperature influence the downstream migration of salmon smolts (Figure 13).

In Figure 13 the fluctuations in water volume of the Lemhi River and Hayden Creek for 1962 is presented. It can be seen very clearly that Hayden Creek is the major contributor to the flooding conditions that are experienced on the lower Lemhi River in June.

After trapping the bypass pipe of Hayden Creek #1 irrigation screen (HC-1) and also counting the number of salmon redds in this stream, it is apparent that Hayden Creek is a minor contributor to the total number of salmon smolts that descend from the Lemhi River. Hence, if the high water conditions in May, June, and July are disregarded from the "Lemhi river at mouth" curve in Figure 13, then the positive relationship between water volume and salmon migration is much more obvious.

In the fall of 1961 there was a 30% increase over 1960 in the number of chinook salmon redds counted on the Lemhi River (Bjornn, 1961). Consequently, we expected to trap an extra large number of salmon smolts in the spring and fall of 1962. We were disappointed, however, and did not trap anywhere near the number of salmon that was anticipated. In the way of an explanation, we can only presume that these fish moved out of the river in the high water periods of March and early April (Figure 13). This belief is substantiated by the high rate of catch in the Kray Meekin trap during March and April, and also, the relatively high rate of catch in the screen traps during the last half of the month of April (Figures 8 and 11). The high water in April

occurred during the first part of the month but screen trapping did not commence until the 18th of the month, and so, probably only the last part of the run was present to enter diversions.

The screen numbered S-10, which is a louver type screen located on the Salmon River, was operated somewhat intermittently throughout the irrigation season. Another reason for the fluctuating catch that is shown in Table 10 is the frequent use of this canal at one half capacity, or less, throughout the summer. August was the only month of the irrigation season when this canal operated for a full month.

Hayden Creek #1 screen was operated for at least a few days each month of the seven month irrigation season. According to our trapping records, this canal diverted very few salmon from the main stream.

Carmen Creek #1 screen was effectively trapped only during April and May. During the remainder of the season the rancher kept a plug in the intake of the bypass pipe in order to conserve water. This plug was removed at least once a week for short periods of time to allow the salmon fingerlings to escape from the canal. No salmon were caught in the trap after the month of May.

Fish movement in the North Fork Salmon River is somewhat unique when compared to the other streams. The trapping done at NF 4 & 5 indicates that salmon fingerlings in this river descend from the river primarily during the spring of the year, and are predominantly age class 0 fish. Table 10 shows that more fish were trapped at this screen during May and June than at any other screen trap.

Amount of water diversion

~~Irrigation pressure~~

The number of "Days traps were in operation" in Table 9, indicates the relative amount of irrigation pressure during 1962. As one can see, the greatest demand for irrigation water was during July and August.

The amount of irrigation decreased in October, but not quite as much as Table 9 indicates. In October a considerable amount of maintenance trouble was experienced because of floating leaves in the river. Each day when leaves or debris caused a malfunction of the screen trap, this particular day was not added into the total number of days in operation. This, then, would cause the number of "Days traps were in operation" to be less than the number of days that the screen was in operation.

Growth of salmon

The average fork lengths of chinook salmon smolts trapped from the Lemhi River in 1962 is presented graphically in Figure 15. The lengths and growth rates are essentially the same for the 1959 and 1961 brood years. In both years an accelerated rate of growth can be observed between August and September. This acceleration can be explained by referring to the maximum water temperature curve in Figure 14. It can be readily seen that in August the water in the Lemhi River was the warmest and then it dropped sharply in temperature during the first part of September. The growth of salmon was slightly inhibited by the 71° F. temperature that occurred in August, but, as the temperature dropped in September to the acceptable tolerance limits of these fish their growth was apparently promoted beyond its previous rate.

The decrease in length of fish measured in October is perplexing. The only logical explanation, I can offer, is that a new man was hired to check the screen traps in October and his length measurements must have been inaccurate.

In Table 11, 'Length Frequencies of Chinook Salmon Smolts Trapped From the Lemhi River During 1962', the statement, " a/ The figures below are considered to be age class I fish" is made. This footnote was placed on

Table 11 because the age classes were separated according to frequency groupings. No scales were taken or read to substantiate these age class groups.

Miscellaneous

Trash fish. Trash fish are more prevalent in the lower part of the Lemhi River than the upper part of the river, as can be seen in Table 8. ~~These fish apparently have infested the Lemhi River from the Salmon River because it is well known that a large percentage of the fish population in this part of the Salmon River is trash fish.~~ Very few trash fish were trapped in the upper part of the Lemhi River or Hayden Creek.

Kray Meekin trapping. During October and November the Kray Meekin trapping was seriously hampered by floating leaves and debris.(Table 12). The trap could only be operated for one half hour on several occasions before it clogged with trash. The last two times the Kray Meekin trap was operated in December, slush ice was flowing in the river which made the successful operation of the trap impossible.

Salvage of salmon fingerlings. After screens were shut down at the terminus of the 1962 irrigation season, it was noted that the pool in front of some of these screens harbored various numbers of salmon smolts. At almost all of these screens, the water level had receded below the mouth of the bypass pipe and the fish were effectively blocked from escaping back into the river.

Fish in this predicament were found at 33 different screens that were located on the Lemhi River, Hayden Creek, Anderson Creek, Carmen Creek, Dahlonega Creek, and North Fork Salmon River. Several methods were employed to catch these fish. A modified cone type, stationary fish trap ~~that was baited,~~ proved to be the most effective. These traps were successful in saving 11,278 salmon smolts and 1,074 rainbow trout.

TABLE 8. SPECIES COMPOSITION OF FISH CATCH IN SCREEN TRAPS FOR THE 1962 IRRIGATION SEASON

SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES

	L-3	L-6	L-7	L-10	L-11	L-17	L-22A	L-31A	L-42	L-45C&D
Chinook salmon (yearlings)	65	327	309	3	7	119	164	25	287	723
Chinook salmon (young of year)	982	612	444	520	19	231	1,006	241	2,122	1,350
Chinook salmon (total)	1,147	939	753	523	26	350	1,170	266	2,409	2,073
Sockeye salmon (smolts)	0	0	0	0	0	0	0	0	0	0
Rainbow trout (all sizes)	12	54	27	14	2	6	23	12	66	50
Brook trout (all sizes)	0	2	1	0	0	1	0	1	0	0
Whitefish (all sizes)	24	8	8	658	2	29	54	6	137	52
Trash fish 1/ (all species)	12,821	2,239	2,996	134	210	946	818	51	151	197
Total number of fish	14,004	3,242	3,785	1,329	240	1,332	2,065	336	2,763	2,372
Days traps were in operation	137	106	172	26	17	90	48	75	132	136

TABLE 8 continued

	L-49	L-50	L-58	L-59	L-63	S-10	HC-1	NF-4&5	CC-1	totals
Chinook salmon (yearlings)	1	387	35	13	147	200	10	8	10	2,940
Chinook salmon (young of year)	346	927	154	230	620	1,150	141	1,232	0	12,327
Chinook salmon (total)	34	1,314	189	243	767	1,350	151	1,240	10	15,267
Sockeye salmon (smolts)	0	0	0	0	0	2	0	0	0	2
Rainbow trout (all sizes)	1	21	2	21	73	146	29	7	46	612
Brook trout (all sizes)	0	0	0	1	27	6	0	0	0	39
Whitefish (all sizes)	11	10	1	35	36	48	1	0	0	1,120
Trash fish (all species)	5	511	29	27	40	4,918	23	41	3	26,160
Total number of fish	364	1,856	221	327	943	6,470	204	1,288	59	43,200
Days traps were in operation	6	145	137	64	180	117	123	33	16	1,760

1/ Trash fish includes: suckers, dace, sculpins, chubs, shiners, and lampreys.

TABLE 9. MONTHLY FISH CATCH IN SCREEN TRAPS FOR THE 1962 IRRIGATION SEASON

SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES

	April	May	June	July	August	September	October	total
Chinook salmon (yearling)	220	890	183	313	284	1,008	42	2,940
Chinook salmon (young of year)	216	1,770	933	536	1,947	3,410	3,515	12,327
Chinook salmon (total)	436	2,660	1,116	849	2,231	4,418	3,557	15,267
Sockeye salmon (smolts)	0	2	0	0	0	0	0	2
Rainbow trout (all sizes)	4	198	92	45	66	152	55	612
Brook trout (all sizes)	0	13	4	4	1	3	14	39
Whitefish (all sizes)	0	69	110	84	70	56	731	1,120
Trash fish 1/ (all species)	1,018	8,037	3,650	5,462	4,637	2,519	837	26,160
Total number of fish	1,458	10,979	4,972	6,444	7,005	7,148	5,194	43,200
Days traps were in operation	34	311	322	365	335	268	125	1,760
Number of screens trapped	5	17	16	16	16	15	11	

1/ Trash fish includes: suckers, dace, sculpins, chubs, shiners, and lampreys.

TABLE 10. CATCH OF CHINOOK SALMON IN SCREEN TRAPS FOR THE 1962 IRRIGATION SEASON

SALMON RIVER, LEMHI RIVER, HAYDEN CREEK, CARMEN CREEK, AND NORTH FORK DRAINAGES

screen number	April		May		June		July		August		September		October	
	salmon caught	days fished	salmon caught	days fished	salmon caught	days fished	salmon caught	days fished	salmon caught	days fished	salmon caught	days fished	salmon caught	days fished
L-3	*1/	*	104	30	31	28	46	31	71	25	100	18	795	5
L-6	185	2	382	31	11	7	3	27	4	22	354	17	*	*
L-7	112	12	285	31	4	18	10	31	91	31	90	21	161	28
L-10	*	*	*	*	*	*	*	*	*	*	64	11	459	15
L-11	*	*	19	4	5	7	2	6	*	*	*	*	*	*
L-17	*	*	255	24	75	19	14	31	1	13	5	3	*	*
L-22A	*	*	70	6	80	16	25	8	221	6	774	12	*	*
L-31A	*	*	24	6	64	30	12	21	166	18	*	*	*	*
L-42	*	*	94	21	256	30	142	28	379	26	815	25	723	2
L-45C&D	*	*	332	22	48	30	220	31	190	26	795	20	488	7
L-49	*	*	*	*	*	*	*	*	*	*	*	*	347	6
L-50	*	*	5	3	45	30	93	31	217	31	815	30	139	20
L-58	*	*	149	25	34	30	1	31	4	31	1	20	*	*

continued on next page

TABLE 10.continued

screen number	April salmon caught	April days fished	May salmon caught	May days fished	June salmon caught	June days fished	July salmon caught	July days fished	August salmon caught	August days fished	September salmon caught	September days fished	October salmon caught	October days fished
L-59	*	*	43	15	27	13	2	5	14	17	148	12	9	2
L-63	*	*	27	28	17	30	9	31	59	30	289	30	366	31
S-10	127	13	49	20	44	6	109	26	804	31	147	18	70	3
HC-1	3	3	114	31	5	15	14	16	3	26	12	26	0	6
NF-4&5	*	*	707	2	370	13	147	11	7	2	9	5	*	*
CC-1	9	4	1	12	*	*	*	*	*	*	*	*	*	*
Totals for month	436	34	2,660	311	1,116	322	849	365	2,231	335	4,418	268	3,557	119
Totals for season	436	34	3,096	345	4,212	667	5,061	1,032	7,292	1,367	11,710	1,635	15,267	1,754
Fish per trap per day 2/	12.82		8.59		3.46		2.33		6.66		16.50		30.02	

1/ * Denotes screen trap was not in operation.

2/ Fish per trap per day = (total number of salmon trapped in one month ÷ number of traps used) ÷ (total number of days screen traps were in operation ÷ number of traps used).

TABLE 11. LENGTH FREQUENCIES OF CHINOOK SALMON SMOLTS TRAPPED FROM THE LEMHI RIVER DURING 1962

Fork length in mm.	Number of smolts measured							
	March	April	May	June	July	August	September	October
60				5	2			
70				26	23	8		
80	2[a]			35	28	30	7	38
90	53	18[a]	11[a]	41	31	35	16	78
100	79	100	55	6	18	14	25	60
110	39	93	100	12[a]	3	1	30	33
120	8	29	27	10		6	10	11
130		1	1	1		6[a]	5	5
140						3	3[a]	5
150						3	1	1
160								[a]
170			1					
180								1
$\bar{X}$ age class 0				81.5	84.7	88.7	103.8	97.4
$\bar{X}$ age class I	99.9	105.6	108.9	115.2				

a/ The figures below are considered to be age class I fish.

TABLE 12. COLLECTION OF CHINOOK SALMON SMOLTS WITH A KRAY MEEKIN TRAP IN THE LEMHI RIVER DURING 1962

Date	Number of fish	Hours fished	Date	Number of fish	Hours fished
3/15	20	4.25	7/21	1	1.5
3/25	23	2.0	7/28	0	1.5
3/29	233	13.0	8/6	1	2.0
4/3	5	2.5	8/11	0	2.0
4/11	99	12.0	8/18	0	2.0
4/20	16	2.0	8/24	0	2.0
4/23	16	2.5	9/7	0	2.0
4/27	31	2.5	9/26	0	.5
5/4	14	2.5	10/12	0	.1
5/9	0	2.0	10/26	0	.5
5/10	1	2.5	11/8	3	.5
5/17	2	1.3	11/15	12	.5
5/31	5	2.0	11/25	8	.25
6/7	0	.5	12/4	5	.75
6/12	0	.5	12/5	6	1.0
6/28	0	.7	12/13	3	1.0
7/6	1	1.0	12/20	0	.1
7/15	0	1.5	12/28	0	.1

Note: Rate of catch is portrayed in Figure 11.

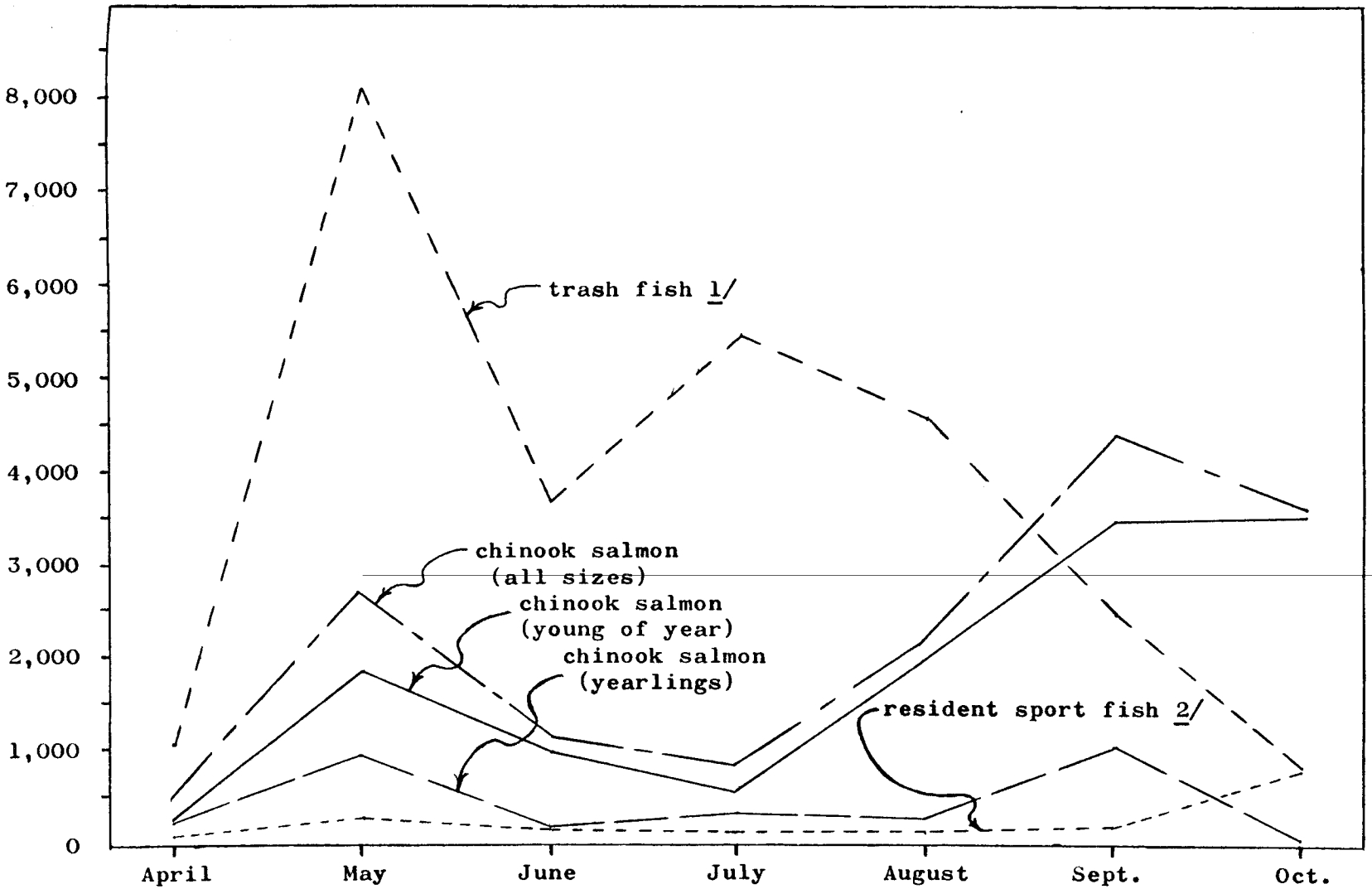


Figure 7. Numbers of fish caught in all screen traps during the 1962 irrigation season.

1/ trash fish includes: suckers, squawfish, dace, sculpins, chubs, shiners, and lampreys.
2/ resident sport fish includes: rainbow, whitefish, and brook trout.

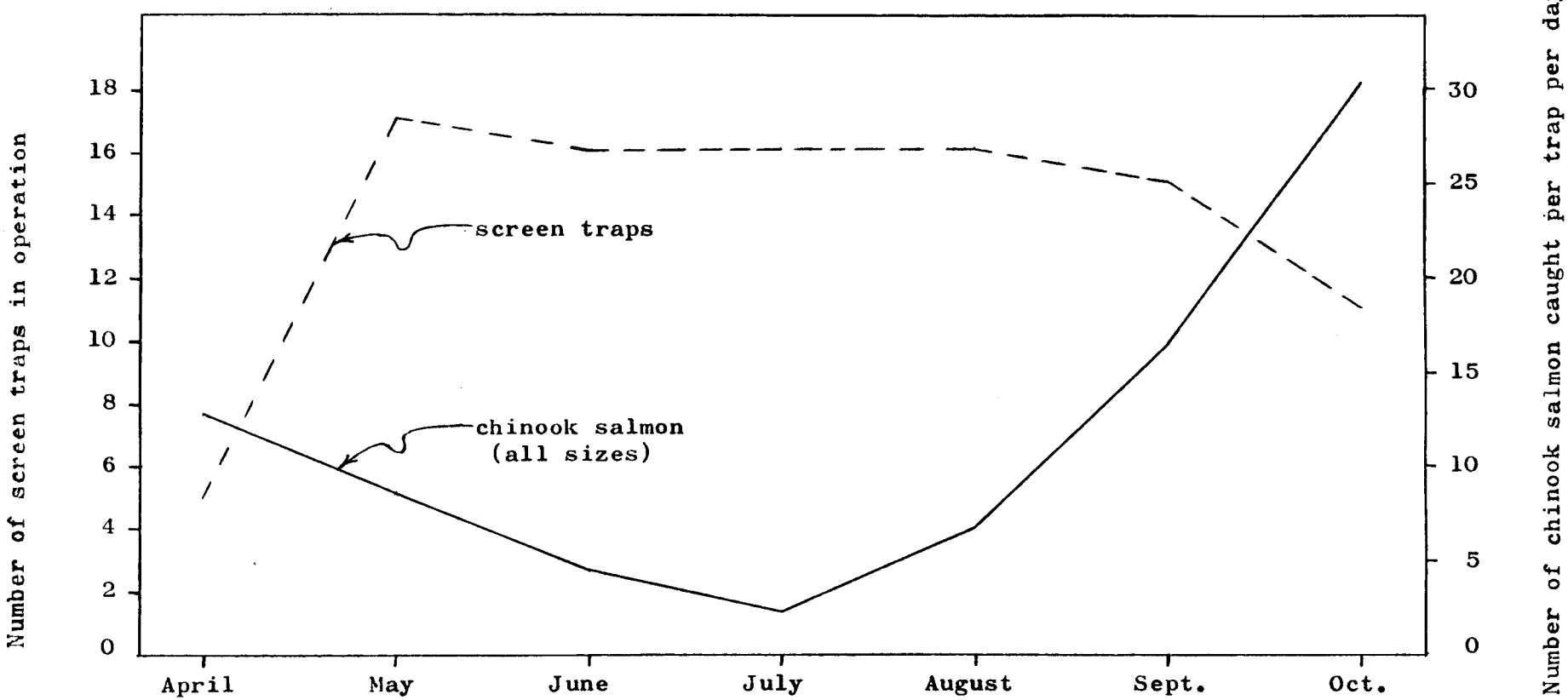


Figure 8. Rate salmon were caught and the number of screen traps in operation throughout the 1962 irrigation season.

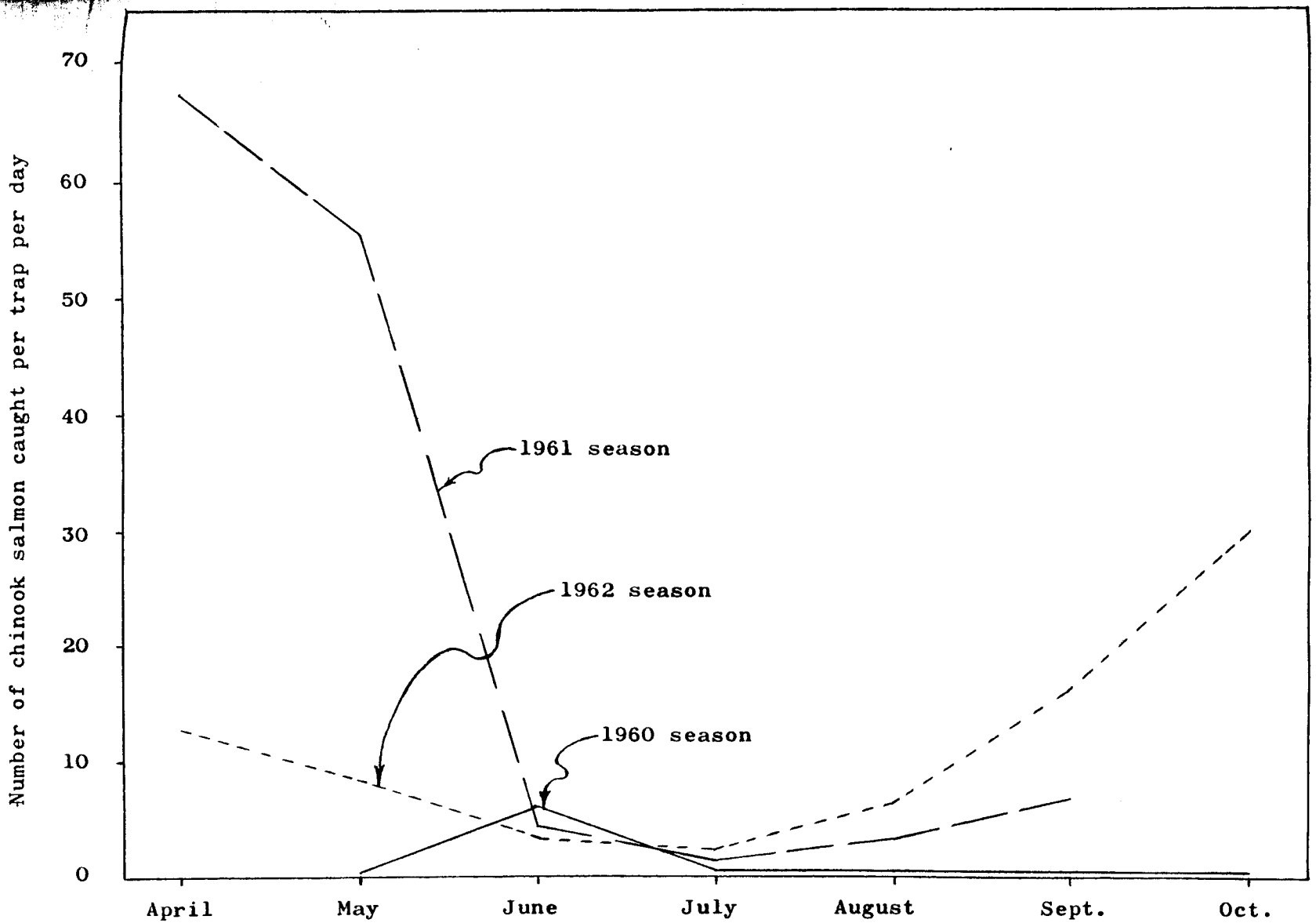


Figure 9. Rate salmon were caught in irrigation screen traps during the 1960, 1961, and 1962 irrigation seasons.

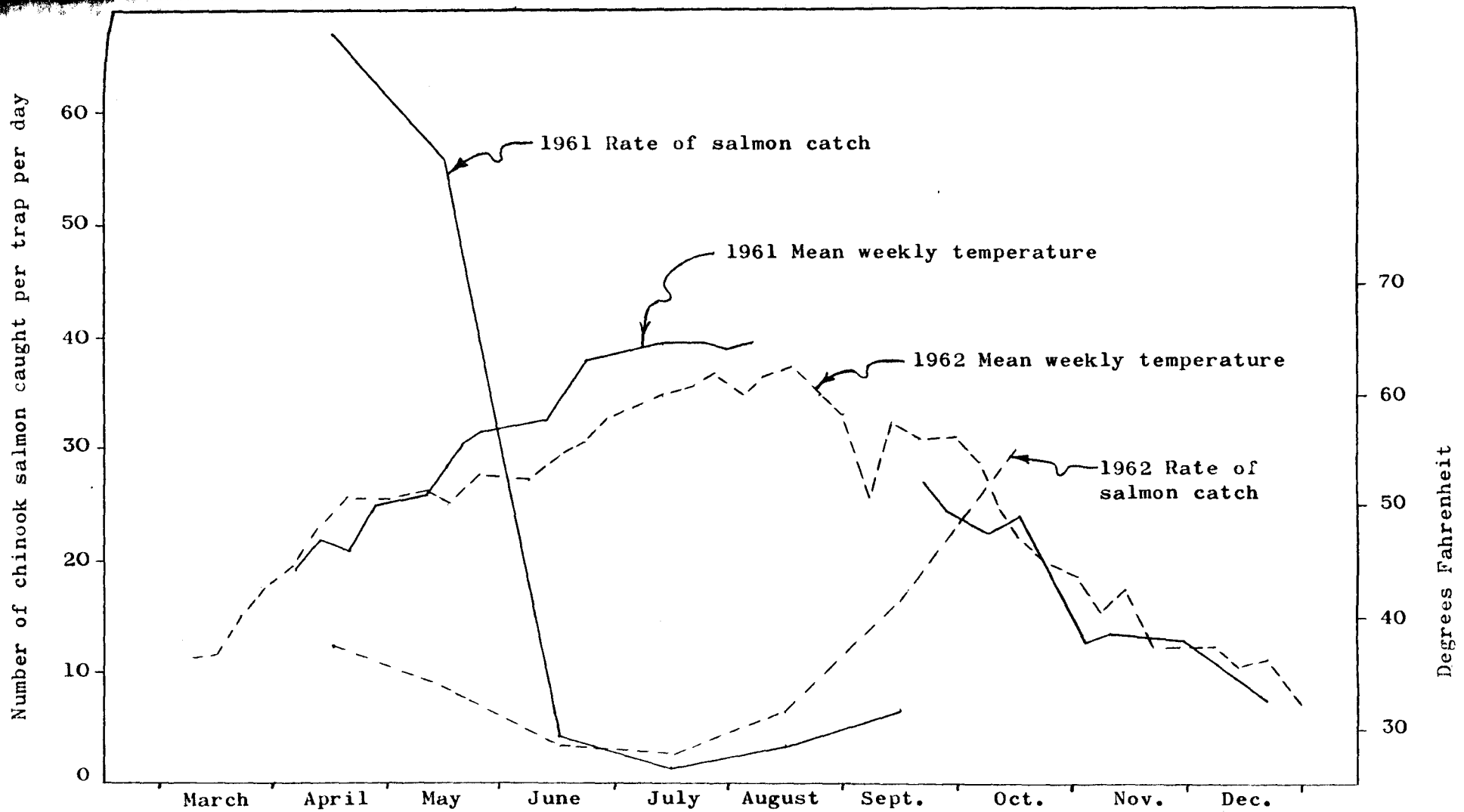


Figure 10. Rate salmon were caught and the mean weekly temperature during the 1961 and 1962 irrigation season.

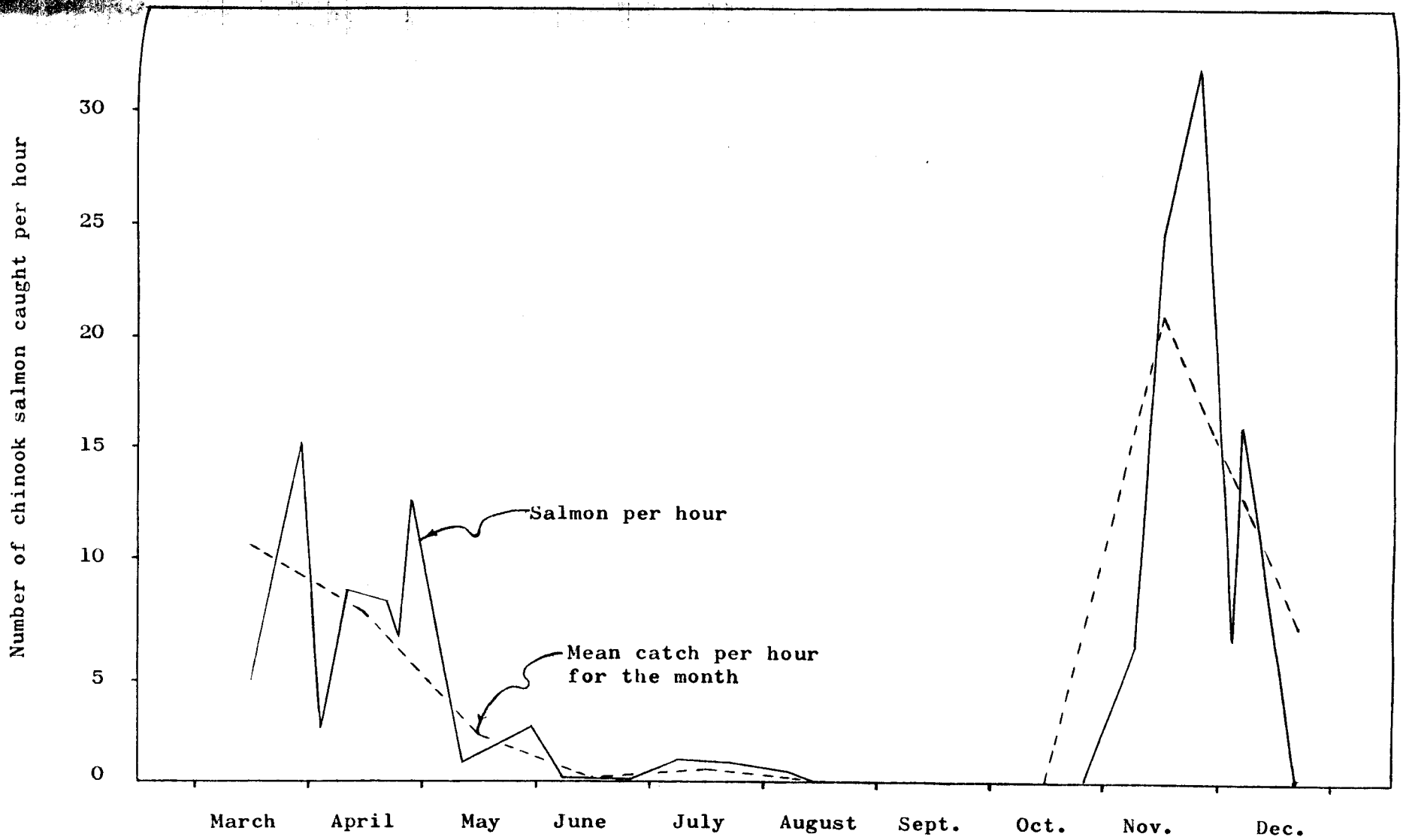


Figure 11. Rate salmon were caught in Kray Meekin trap at mouth of Lemhi River during 1962.

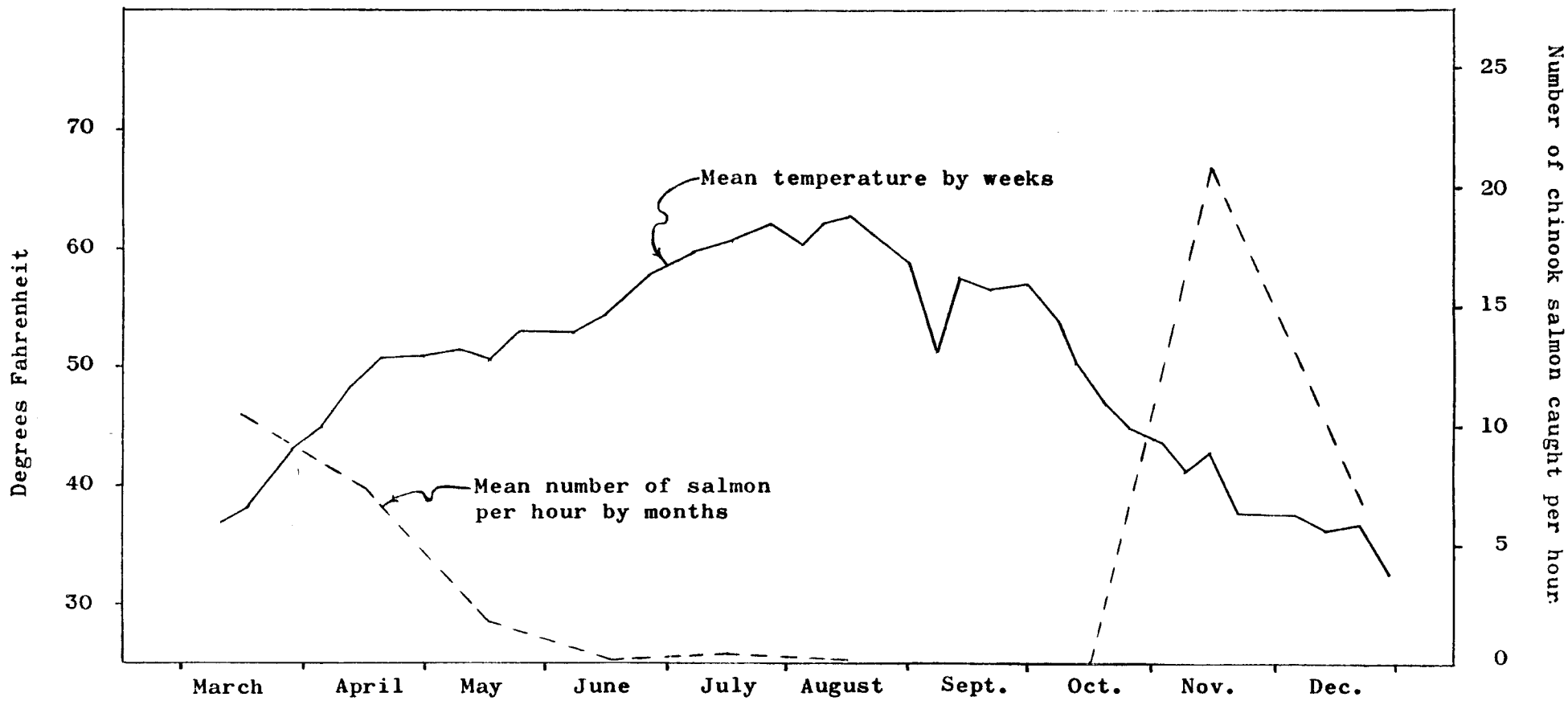


Figure12. Temperature recordings and salmon catch in Kray Meekin trap at mouth of Lemhi River during 1962.

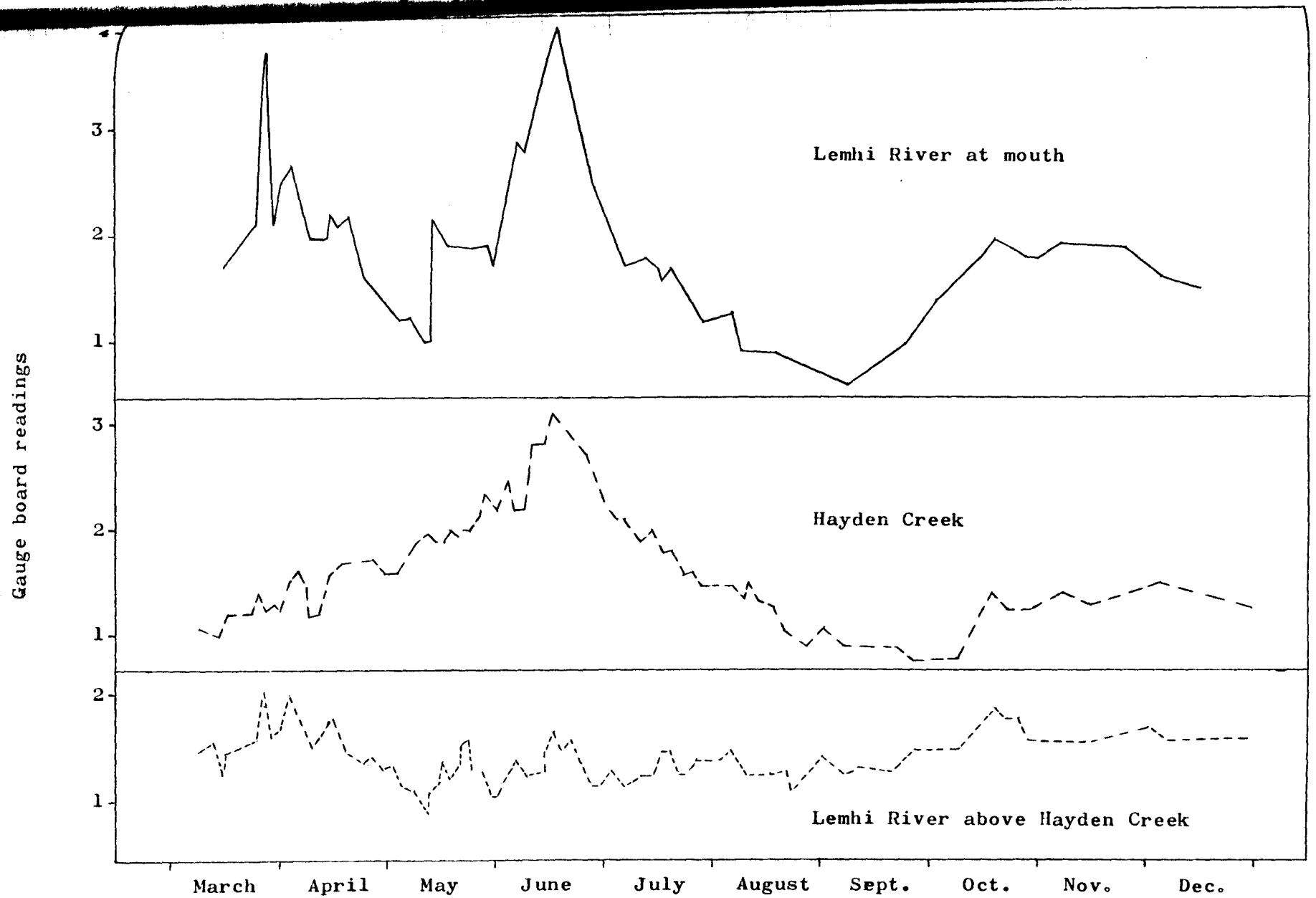


Figure 13. Fluctuations in volume of the Lemhi River and Hayden Creek during 1962.

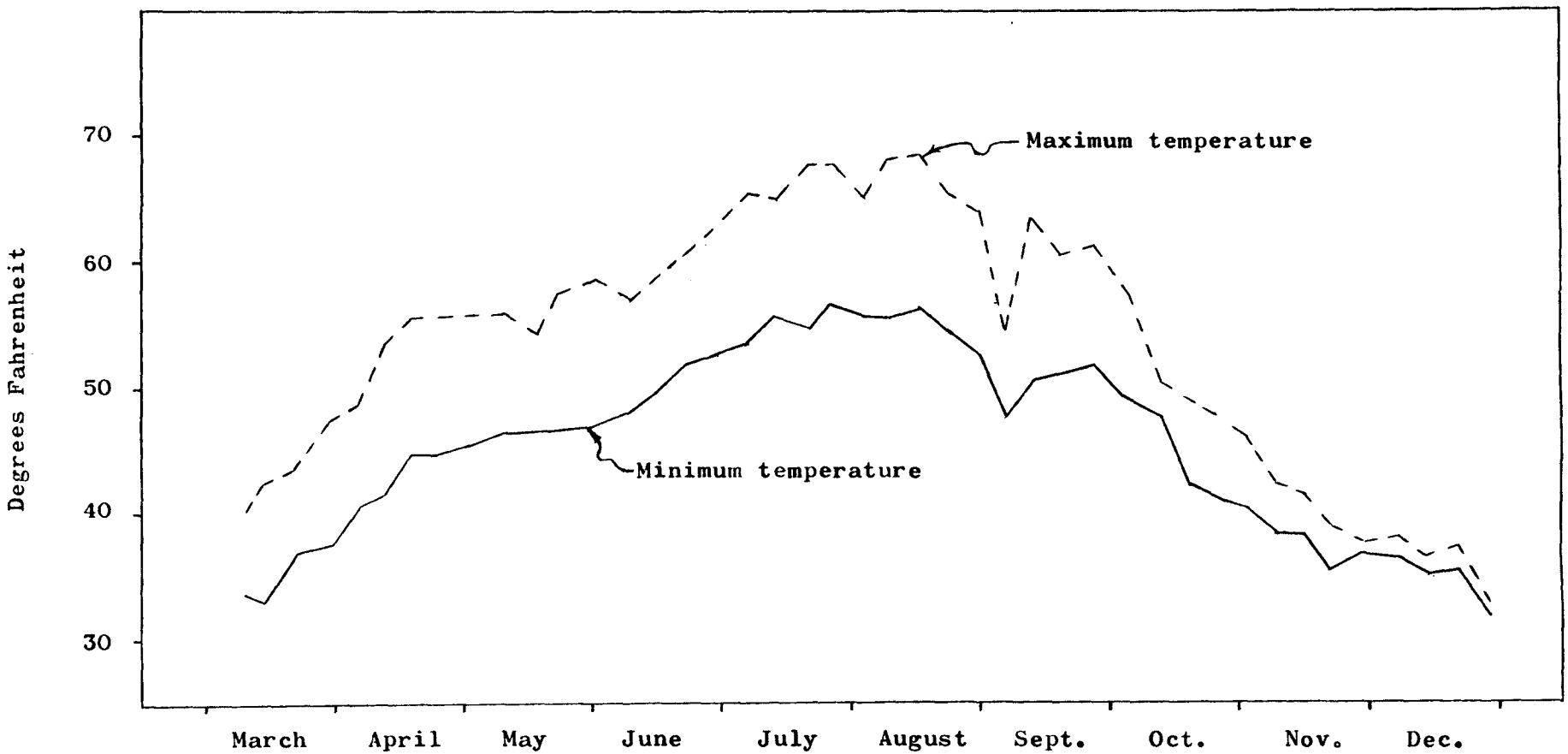


Figure 14. Weekly mean maximum and minimum temperature recordings for the Lemhi River during 1962.

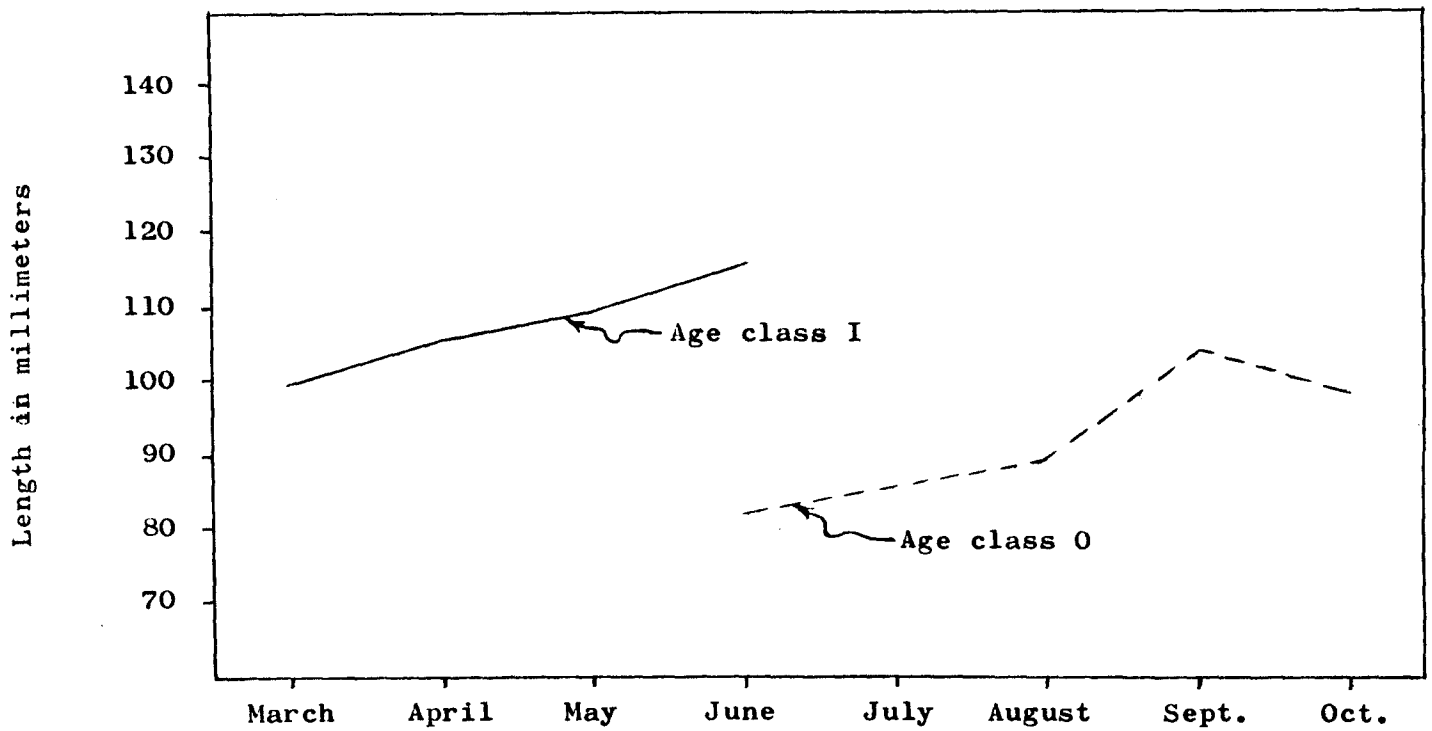


Figure 15. Average fork lengths of chinook salmon smolts trapped from the Lemhi River in 1962.

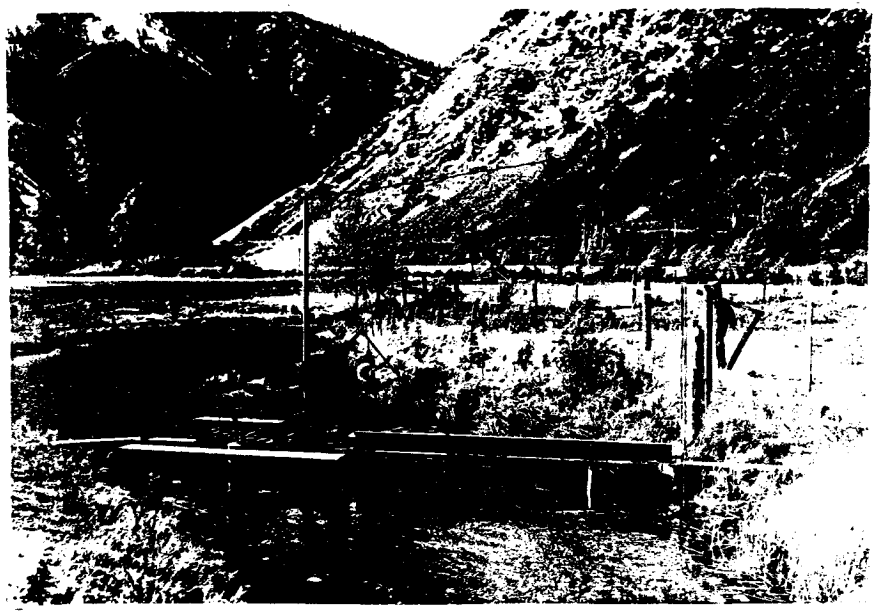


Figure 16. Perforated plate irrigation screen on the North Fork Salmon River that is powered by an electrical motor.

Figure 17. Perforated plate irrigation screen on the Lemhi River that is powered by a paddlewheel.

Figure 18. Wing dam on the Lemhi River partially blocking stream. Intake of the canal is on the left.

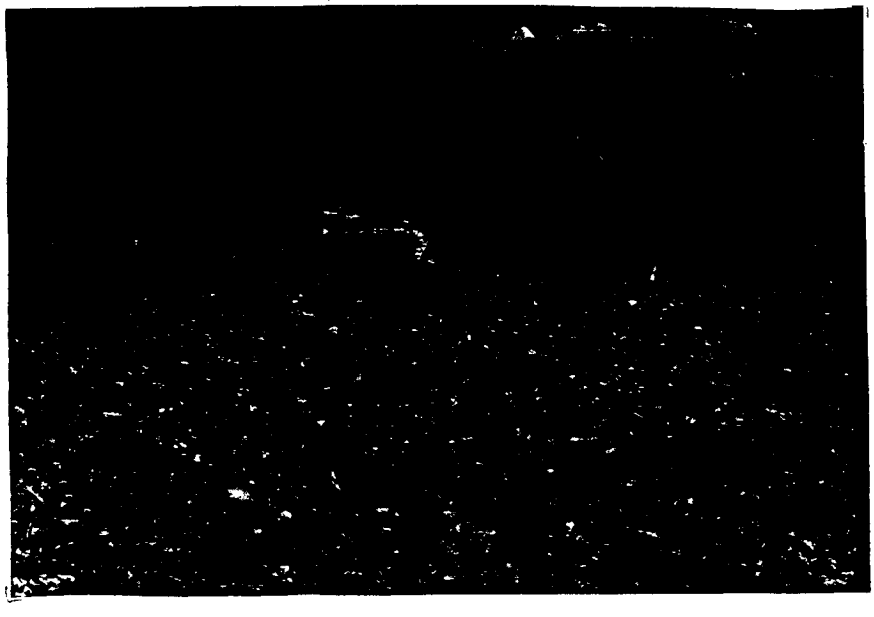


Figure 19. Wing dam on the Lemhi River extending completely across river. Intake of canal is on the right.

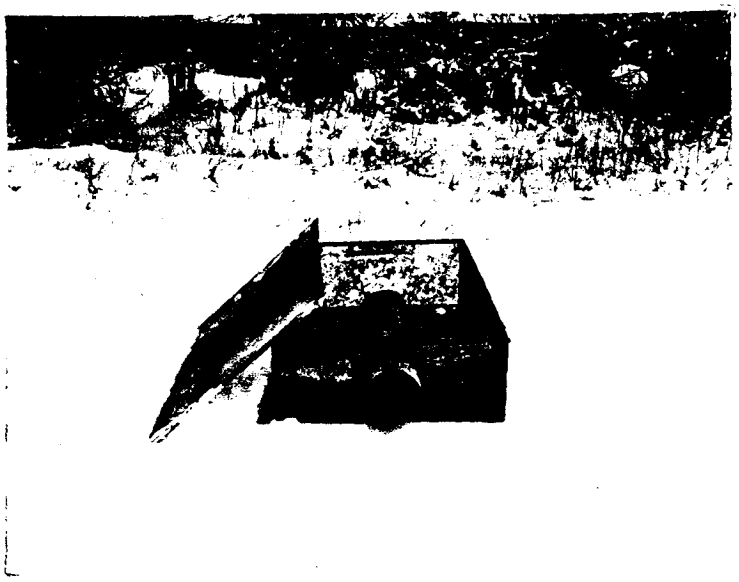


Figure 20. Perforated plate-type fish trap used on the bypass pipes of the irrigation screens. Trap is shown with lid leaning against side of trap.

Figure 21. Permanent-type fish trap in the bypass pipeline of Lemhi River irrigation screen. Picture shows the trap raised out of wooden box, without a lid, and the hoist above the trap.

DISCUSSION

To project a figure that would accurately denote the total number of salmon smolts saved by irrigation screens on the Lemhi River would be very difficult, if not impossible. As these salmon descend from the river, they are undoubtedly diverted into, and then bypassed back to the river, by more than one screen. These fish will be bypassed by more screens on the upper part of the river than on the lower part because of the higher proportion of fish to water on the upper part. As yet, the average number of times a smolt is saved by a screen before reaching the Salmon River has not been ascertained. Until we determine this number, we cannot, with any confidence, calculate how many fish were saved, and thus contributed, to the run of downstream migrant salmon, by the irrigation screens.

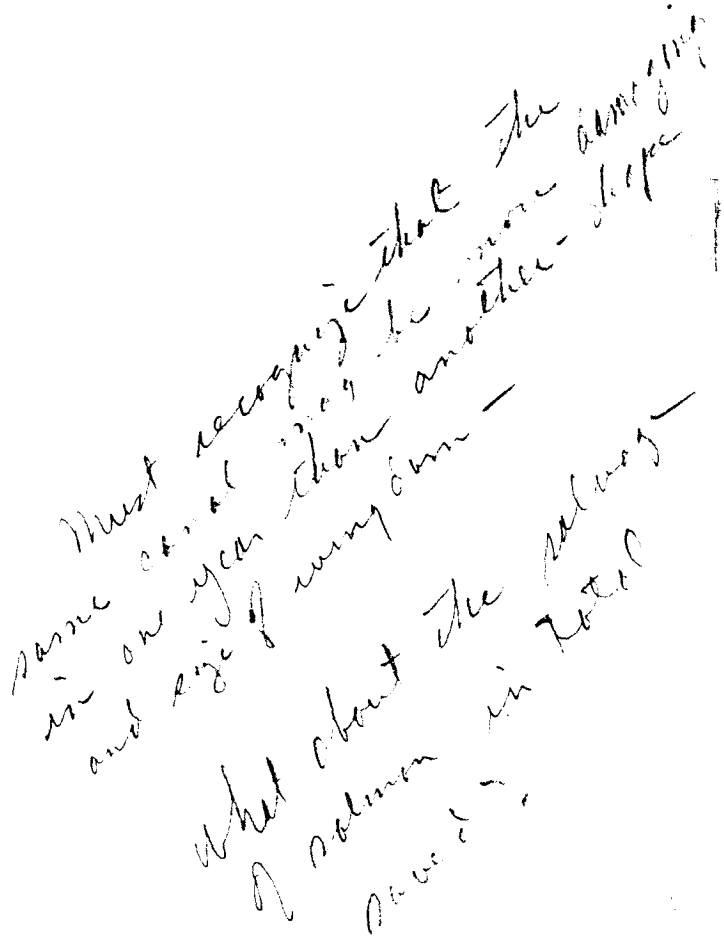
By computing the daily fish loss per unit volume of flow, the approximate number of salmon bypassed by the screens can be figured. In calculating this figure, the fish trapping data from 1962 is used since the screen construction on the Lemhi River was completed in early June, 1962.

The average number of irrigation days per screen in 1962, according to our screen trapping data, was 125 days. If the average canal volume (13.5 cfs) is multiplied by the number of irrigation screens (84), the calculated volume of water diverted daily from the Lemhi River is 1134 cfs.

The daily loss of salmon per cfs for each screen trapped during the 1962 irrigation season was calculated by using the following formula: (Total number of salmon trapped in one screen during 1962 season ÷ average volume of the canal) ÷ total number of irrigation days.

These values were then averaged to arrive at a mean of .6455 salmon per cfs per day for all the screens on the Lemhi River. When this daily figure of .6455 fish per cfs is multiplied by the calculated volume of water diverted daily from the Lemhi River, the total daily number of fish diverted for the entire river is 73,2~~,827~~ young salmon. When this figure is then applied to an average irrigation season of 125 days, the total number of salmon bypassed by the irrigation screens in 1962 was a calculated 91,499 fish.

The value of this projected figure is quite questionable since there is such a great fluctuation from year to year in the figures which are expanded so greatly to arrive at this number. If the information collected in 1961 is used to calculate a similar figure, even though three canals were unscreened, the number of bypassed fish is calculated as being 279,103 fingerling salmon, or just about 3 times as many fish as were bypassed in 1962. I calculated this 1961 value merely to illustrate how much a figure of this nature can vary when it is based on such highly expanded values.



These values were then averaged to arrive at a mean of .6455 salmon per cfs per day for all the screens on the Lemhi River. When this daily figure of .6455 fish per cfs is multiplied by the calculated volume of water diverted daily from the Lemhi River, the total daily number of fish diverted for the entire river is 732 young salmon. When this figure is then applied to an average irrigation season of 125 days, the total number of salmon bypassed by the irrigation screens in 1962 was a calculated 91,499 fish.

The value of this projected figure is quite questionable since there is such a great fluctuation from year to year in the figures which are expanded so greatly to arrive at this number. If the information collected in 1961 is used to calculate a similar figure, even though three canals were unscreened, the number of bypassed fish is calculated as being 279,103 fingerling salmon, or just about 3 times as many fish as were bypassed in 1962. I calculated this 1961 value merely to illustrate how much a figure of this nature can vary when it is based on such highly expanded values.

CONCLUSION

It appears that the number of fish saved by the screening of the irrigation diversions can only be expressed intelligently by the increase or the decrease in the magnitude of the downstream migrant salmon runs. Since the tools we now have to measure this increase or decrease are of a sampling nature, we must, therefore, express these population trends in relative terms.

To date the most meaningful expression we have of fish movement past the irrigation screens is in terms of the daily catch of salmon per screen trap. This rate is preferred for comparing one year with another because the number of screen traps and trapping days will vary from year to year.

The salmon catch per hour rate that was used for the Kray Meekin trapping is a measure of salmon movement within the stream. When more Kray Meekin trapping is done in successive years these rates will be valuable for comparing one year with another and for comparison with the screen trapping rates. ~~Both of these rates can be used, in the future, as an index to the size of the~~ downstream migrant runs which, in turn, is an indirect measurement of the ~~efficiency~~ of irrigation screens ~~in deflecting salmon fingerlings from the canals back into the river.~~

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